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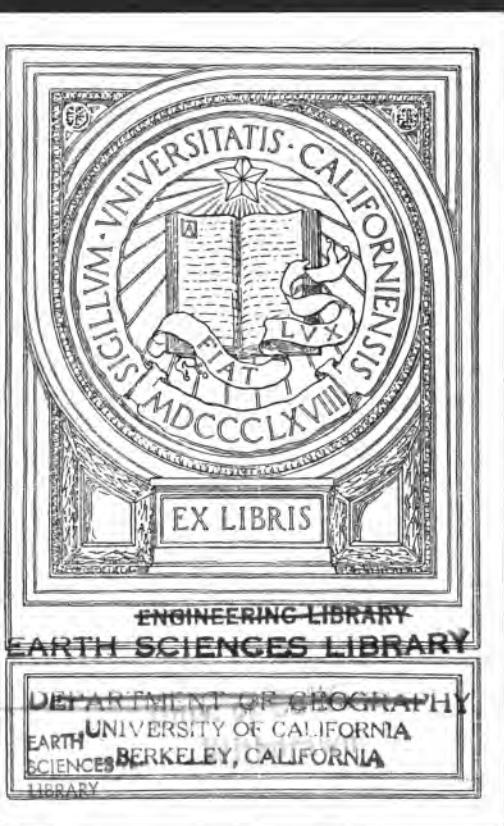
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CALIFORNIA-WASHINGTON ARC OF  
PRECISE TRIANGULATION  
A. L. BALDWIN



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Serial No. 196

DEPARTMENT OF COMMERCE  
U. S. COAST AND GEODETIC SURVEY  
E. LESTER JONES, DIRECTOR

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# CALIFORNIA-WASHINGTON ARC OF PRECISE TRIANGULATION

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Special Publication No. 13  
(Second Edition)

By

A. L. BALDWIN



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THE CALIFORNIA-WASHINGTON ARC OF PRECISE  
TRIANGULATION.

## GENERAL STATEMENT.

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The arc of precise triangulation, the results of which are here published, extends from latitude 39°, in northern California, to Puget Sound, Wash. The data for this arc, together with a discussion of the least-squares adjustment and other purely scientific matter, were originally published in United States Coast and Geodetic Survey Special Publication No. 13, by A. L. Baldwin, computer. The original publication is now exhausted, and there is reprinted here only that part of the data which is of value to the engineer or surveyor for the control of surveys, namely, the geographic positions, elevations, and descriptions of stations.

## FIELD WORK.

Early in 1903 Assistant O. B. French organized a reconnaissance and signal-building party at Eugene, Oreg. With this party Mr. French made a reconnaissance through the Willamette Valley to connect with the triangulation of the Columbia River. He then returned to Eugene with part of the party to do the observing, leaving the rest of the party to build the signals. The observing was carried as far as the reconnaissance had been completed by the latter part of September. Both parties then returned to Eugene, where a base net was laid out and partly observed. Mr. French then made a reconnaissance to the southward to connect with the precise triangulation along the thirty-ninth parallel, which he completed by the middle of November.

In 1904 Assistant J. S. Hill was also assigned to the work, thus allowing Mr. French to devote more time to the reconnaissance without delay to the observing party. The observing started at Marysville Butte soon after May 1, and the season closed about the middle of November. During this time the whole scheme was completed between the transcontinental triangulation along the thirty-ninth parallel and the work of the previous season. Mr. French spent about a month of this season in making a reconnaissance from the Columbia River to Puget Sound.

During the season of 1905 the organization of the parties was the same as in the previous season. The work of this season started in the vicinity of the Columbia River, but though every effort was made, the work was not completed to a connection with the Puget Sound triangulation. This was partly due to the bad weather and to the difficult character of the country, and was partly due to the necessity of revising the reconnaissance in order to eliminate some very high signals and an excessive amount of cutting of timber.

The work of the last season, 1906, was in charge of Assistant J. S. Hill, who organized the party on June 11 and completed the work on July 26.

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## APPENDIX. THE LEAST-SQUARES ADJUSTMENT.

The geographic positions of Snow Mountain West and Mount Helena, together with the length and azimuth of the line between them, was held fixed as determined by the thirty-ninth parallel triangulation. A single least-squares adjustment served for the entire precise scheme. The Willamette base and the Tacoma base required the use of two length equations, and the Laplace azimuths at Gazelle, Willamette, and Tacoma necessitated three azimuth equations. The maximum correction to a direction, from the adjustment, was  $2''.03$ , and the probable error of an observed direction was  $\pm 0''.53$ .

The average closing error of the 148 triangles was  $1''.22$ .

## ACCORD OF BASES.

There are three bases which serve to fix the lengths in the triangulation discussed in this report.

The Yolo base in the thirty-ninth parallel triangulation fixed the length of the line Snow Mountain West-Mount Helena and also the other two sides of triangle Snow Mountain West-Marysville Butte-Mount Helena. The Willamette and Tacoma bases furnish two important tests of the accuracy of the triangulation.

In solving the normal equations in each section of the figure adjustment the length equation was, as usual, assigned to the last place, so that after all the conditions relating to triangle closures and ratios of length had been satisfied the discrepancy in length became known. In the following table the discrepancies developed between bases are given in terms of the seventh place of logarithms and are also expressed as ratios. A plus sign before the discrepancy expressed in terms of logarithms means that the first base mentioned is longer as measured than as computed through the intervening triangulation from the second base mentioned.

Bases	Discrepancy in seventh place of logarithms	Discrepancy expressed as a ratio
Mount Helena-Snow Mountain West to Willamette base.....	+79	1-55000
Willamette base to Tacoma base.....	-19	1-229000

## ACCORD OF AZIMUTHS.

True geodetic azimuths were determined at three Laplace stations, viz., at Gazelle astronomic, Eugene astronomic, and Tacoma astronomic. In each case the true geodetic azimuth as held fixed was larger than the azimuth as computed through the triangulation, the direction of the computation being from the south to the north. At Gazelle astronomic the discrepancy was  $3''.14$ , at Eugene astronomic  $2''.98$ , and at Tacoma astronomic  $3''.95$ .

## THE NORTH AMERICAN DATUM.

Concerning the actual use of the table of geographic positions, it is necessary to explain the "North American datum," which serves as the basis for all the geodetic values in this report.

Early in the year 1913 the Superintendent of the U. S. Coast and Geodetic Survey was notified by the director of the Comisión Geodésica Mexicana and by the chief astronomer of the Dominion of Canada Astronomical Observatory that the so-called United States standard datum had been adopted as the datum for the triangulation of those organizations. They also reported that the Clarke spheroid of 1866, now used in the United States, would be used by them.

Owing to the international character of the datum adopted by the three countries, the Superintendent of the U. S. Coast and Geodetic Survey changed its designation from the "United States standard datum" to the "North American datum."

#### EXPLANATION OF POSITIONS, LENGTHS, AND AZIMUTHS, AND OF THE NORTH AMERICAN DATUM.

All of the positions and azimuths have been computed upon the Clarke spheroid of 1866, as expressed in meters, which has been in use in the U. S. Coast and Geodetic Survey for many years.

After a spheroid has been adopted and all the angles and lengths in a triangulation have been fully fixed it is still necessary, before the computation of latitudes, longitudes, and azimuths can be made, to adopt a standard latitude and longitude for a specified station and a standard azimuth of a line from that station. For convenience the adopted standard position (latitude and longitude) of a given station, together with the adopted standard azimuth of a line from that station, is called the geodetic datum.

The triangulation in the United States was commenced at various points and existed at first as a number of detached portions in each of which the geodetic datum was necessarily dependent only upon the astronomic stations connected with that particular portion. As examples of such detached portions of triangulation there may be mentioned the early triangulation in New England and along the Atlantic coast, a detached portion of the transcontinental triangulation centering on St. Louis and another portion of the same triangulation in the Rocky Mountain region, and three separate portions of triangulation in California, in the latitude of San Francisco, in the vicinity of Santa Barbara Channel and in the vicinity of San Diego. With the lapse of time these separate pieces expanded until they touched.

The transcontinental triangulation, the office computation of which was completed in 1899, joined all the detached portions mentioned and made them one continuous triangulation. As soon as this took place the logical necessity existed of discarding the old geodetic data used in these various pieces and substituting one for the whole country, or at least for as much of the country as is covered by continuous triangulation. To do this was a very tedious piece of work and involved much preliminary study to determine the best datum to be adopted. On March 13, 1901, the superintendent adopted what was known from that time until 1913 as the United States standard datum, but is now known as the North American datum, and it was decided to reduce the positions to that datum as rapidly as possible. The datum adopted was that formerly in use in New England, and therefore its adoption did not affect the positions which had been used for geographic purposes in New England and along the Atlantic coast to North Carolina, nor those

in the States of New York, Pennsylvania, New Jersey, and Delaware. The adopted datum does not agree, however, with that used in the Transcontinental Triangulation and in the Eastern Oblique Arc of the United States, publications which deal primarily with the purely scientific problem of the determination of the figure of the earth and which were prepared for publication before the adoption of the new datum.

As the adoption of such a standard datum was a matter of considerable importance, it is in order here to explain the desirability of this step more fully.

The main objects to be attained by the geodetic operations of the U. S. Coast and Geodetic Survey are, first, the control of the charts published by the Survey; second, the furnishing of the geographic positions (latitudes and longitudes), of accurately determined elevations, and of distances and azimuths, to officers connected with the Survey and to other organizations; third, the determination of the figure of the earth. For the first and second objects it is not necessary that the reference spheroid should be accurately that which most closely fits the geoid within the area covered, nor that the adopted geodetic datum should be absolutely the best that can be derived from the astronomic observations at hand. It is simply desirable that the reference spheroid and the geodetic datum adopted shall be, if possible, such a close approximation to the truth that any correction which may hereafter be derived from the observations which are now, or may become, available shall not greatly exceed the probable errors of such corrections. It is, however, very desirable that one spheroid and one geodetic datum be used for the whole country. In fact, this is absolutely necessary if a geodetic survey is to perform fully the function of accurately coordinating all surveys within the area which it covers. This is the most important function of a geodetic survey. To perform this function, it is also highly desirable that when a certain spheroid and geodetic datum have been adopted for a country they be rigidly adhered to, without change for all time unless shown to be largely in error.

In striving to obtain the third object, the determination of the figure of the earth, the conditions are decidedly different. This problem concerns itself primarily with astronomic observations of latitude, longitude, and azimuth and with the geodetic positions of the points at which the astronomic observations were made, but is not concerned with the geodetic positions of other points fixed by the triangulations. The geodetic positions (latitudes and longitudes) of comparatively few points are therefore concerned in this problem. However, in marked contrast to the statements made in preceding paragraphs, it is desirable in dealing with this problem that with each new important accession of data, a new spheroid fitting the geoid with the greatest possible accuracy, and new values of the geodetic latitudes, longitudes, and azimuths of the highest degree of accuracy should be derived.

The North American datum was adopted with reference to positions furnished for geographic purposes but has no reference to the problem of the determination of the figure of the earth. It was adopted with reference to the engineer's problem of furnishing standard positions and does not affect the scientist's problem of the determination of the figure of the earth.

The principles which guided in the selection of the datum to be adopted were: First, that the adopted datum should not differ widely from the ideal datum for which the sum of the station errors in latitude, longitude, and azimuth should each be zero; second, it was desirable that the adopted datum should produce minimum changes in the publications of the U. S. Coast and Geodetic Survey, including its charts; and third, it was desirable, other things being equal, to adopt that datum which allowed the maximum number of positions already in the office files to remain unchanged, and therefore necessitated a minimum amount of new computation. These considerations led to the adoption, as the standard, of that datum which had been in use for many years in the northeastern group of States and along the Atlantic coast as far south as North Carolina.

An examination of the station errors of the astronomical stations so far reduced, scattered widely over the United States from Maine to Louisiana and to California, indicated that this datum approaches closely the ideal for which the algebraic sum of the station errors of each class would be zero.

The North American datum, upon which the positions and azimuths given in this publication depend, may be defined in terms of the position of the station Meades Ranch, Kansas, as follows:

$$\begin{array}{lll} \phi = 39 & 13 & 26.686 \\ \lambda = 98 & 32 & 30.506 \\ \text{a to Waldo} = 75 & 28 & 14.52 \end{array}$$

Points are then said to be upon the North American datum when they are connected with the station Meades Ranch by a continuous triangulation, through which the corresponding latitudes, longitudes, and azimuths have been computed on the Clarke spheroid of 1866, as expressed in meters, starting from the above data.

#### USE OF HORIZONTAL CONTROL DATA.

The plan or map for any extensive engineering project, whether or not map construction is the primary object, should have all of its parts properly correlated and should be on the same datum as adjacent surveys. Federal and State mapping organizations have long been aware of the necessity for having all surveys based upon a common datum, but the local engineers and surveyors in this country have too often in the past been content, and in many cases compelled, to use a local datum for their surveys. The future economic disadvantage of such a system is now becoming recognized, with the result that city and county surveys are being more generally placed upon a permanent basis by connecting them to stations on the North American datum.

One other factor must be taken into consideration by the engineer of to-day. As the States develop industrially they will undoubtedly follow the lead of one of the Eastern States, Massachusetts, which with splendid foresight has extended its triangulation control over the entire State for the purpose of defining property boundaries in terms of latitude and longitude. The advantage of such a system is well stated in the following extracts from the Report on the Maryland Oyster Survey:

The difficulties of accurately locating and permanently defining the boundaries of a farmer's plantation on land, even with the aid of monuments, public

roads, streams of water, and other points of reference are often great, judging from the disputes frequently arising in connection with boundaries.

There is only one point on the earth's surface at the intersection of any parallel of latitude and any one meridian of longitude, and therefore there can be no dispute as to the meaning of such a geographic definition of the location of a point, even though all the original triangulation station marks used in determination, together with the chart on which its position was originally plotted, have been totally destroyed.

In the case of the destruction of an original triangulation station mark any other point defined by a geographic position, a competent geodetic engineer can reestablish its exact location by means of a new system of triangulation connecting with other distant triangulation marks which have not been destroyed.

In a section of the country covered by adequate geodetic control the data are available to the engineer for any of the following operations, in addition to its possible future use as a basis for cadastral surveys:

(1) **Extensive mapping.**—The topographer needs as initial data for beginning a topographic survey the distance and direction between two points and the geographic position of one of them, latitude and longitude, on the North American datum. His local triangulation, based on this control, will prevent the accumulation of excessive errors as he carries on his mapping operations. In the event that the available precise triangulation in that region has lines of too great length to join to conveniently he can measure a base and azimuth at some place visible from a precise or a primary triangulation station and connect his base to the station by triangulation, thus obtaining proper geographic positions for his local survey.

Instructions for secondary (formerly called tertiary) triangulation suitable for the control of local surveys, may be found in U. S. Coast and Geodetic Survey Special Publication No. 26, which can be had at a nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C.

(2) **Boundary lines.**—If it is desired to locate or to delineate accurately and permanently the boundaries of political subdivisions such as States, counties, or cities, the methods indicated in the preceding paragraph may be followed. Whenever possible, a line of the adjusted triangulation should be used as a basis for local surveys rather than a point, since a line gives the three essentials, position, length, and direction.

(3) **Local intensive surveys.**—The necessity for such surveys arises most frequently in connection with extensive improvements over a considerable area, or as a basis for city planning, where the needs of a city are being anticipated for a number of years. Here the requirements are somewhat different from those in the preceding operations, for it is often necessary to extend precise primary control in considerable detail over the entire area affecting secondary triangulation or traverse then being used to furnish additional points for the survey. In such a control survey the triangulation should invariably be started from a line of adjusted triangulation on the North American datum.

While it may be noted in the preceding paragraphs that the azimuth and length of one line and the geographic position of one end of that line constitute the essential data for the complete utilization of old work as a basis for new work, there is always grave danger in depending upon this minimum of data. There may be failure

identify the true station mark, or the mark, though genuine, may have been tampered with or otherwise disturbed in position. This will, of course, introduce an error into the new work based on these stations. It is the present practice in this Survey, unless unusual conditions render it unnecessary, to establish the integrity of the recovered points by using at least three old stations as a basis for new work, the third station serving as a check for the two stations on which the new work may actually depend.

In local surveys where the area is of limited extent it is usually desirable to use a system of plane coordinates, the origin being connected to some point of the precise or primary triangulation scheme. Tables for computing plane coordinates from geographic positions are found in U. S. Coast and Geodetic Survey Special Publication No. 71.

The U. S. Coast and Geodetic Survey will be glad to give advice on any problem arising out of the use of its control points or on any proposed extension of triangulation from them.

#### EXPLANATION OF TABLES.

#### ARRANGEMENT OF TABULATED DATA.

In the tables of positions the latitude and longitude of each point are given on the North American datum (see p. 2); also the length and azimuth of each line observed over, whether in one way or both ways, to other points of the triangulation. NO LENGTHS OR AZIMUTHS ARE REPEATED, AND FOR A GIVEN LINE THE LENGTH AND AZIMUTH WILL BE FOUND OPPOSITE THE POSITION OF ONE OR THE OTHER OF THE TWO STATIONS INVOLVED.

The distances between stations are given in both meters and feet. To facilitate further the use of the tables, a column is given of the logarithms of the lengths in meters. It must be remembered that it is the logarithm of the length in meters which is derived first in the computation, the lengths in meters given in this table being derived from the corresponding logarithm and the lengths in feet in turn derived from the lengths in meters by the aid of the conversion tables on pages 37-44. Where further work of considerable extent is contemplated, an accumulation of error in the last two operations can be avoided by using the logarithm.

#### EXPLANATION OF LENGTHS.

The lengths as given in the tables are all reduced to sea level. If the actual length of a line simply reduced to the horizontal is desired—that is, its length in its actual elevation on the surface of the earth—it may be obtained by adding to the sea level length as given in meters a correction = (length of line as given in meters) times

$$\left[ \frac{\text{mean elevation of the two ends of the line in meters}}{6\ 370\ 000} \right].$$

The maximum value of this correction does not exceed  $\frac{1}{2000}$  of the length of any line of the triangulation here published. The error introduced by the use of the above approximate formula does not exceed  $\frac{1}{100000}$  of the length of any portion of this triangulation.

**AZIMUTH AND BACK AZIMUTH.**

Because of the convergence of the meridians the azimuth and back azimuth of a line do not differ by exactly  $180^{\circ}$ , the amount of the divergence varying with the latitude and the difference of longitude of the two points. To illustrate from the tables, page 10, the azimuth from Mears to Bally is  $16^{\circ} 28' 16.''81$ , while the back azimuth, or the azimuth from Bally to Mears is  $196^{\circ} 20' 20.''42$ .

The azimuths of the triangulation lines offer a very convenient and accurate means of testing the error of the magnetic needle on a surveyor's transit, and even the azimuth over such short distances as those between a station mark and its reference mark may be used for this purpose with fair accuracy, provided the distance is greater than 100 feet.

**ACCURACY OF DATA INDICATED IN TABLES.**

The rule followed in recent publications of this office has been to give latitudes and longitudes to thousandths of seconds for all points, the positions of which are fixed by fully adjusted triangulations. Points, the positions of which are given to hundredths of seconds only, are marked by footnotes as being without check (observed from only two stations) or checked by vertical angles only.

In the columns giving azimuths, distances, and logarithms of distances, the accuracy is indicated to a certain extent by the number of decimal places given, it being understood that in each case two doubtful figures are given. In some cases there is very little doubt of the correctness of the second figure from the right, while in a few cases some doubt may be cast on the third figure from the right.

**HOW TO FIND THE DATA DESIRED.**

Following the index at the back of this publication are seven maps. The first is an index map showing all areas in the United States covered by published triangulation rigidly computed on the North American datum. Following that is an index map showing the boundaries of each of the triangulation sketches. (Figs. 3 to 7.) The other five are detailed maps showing the scheme of triangulation plotted by latitudes and longitudes on a polyconic projection.

Having found from these sketches the names of the points desired, the tables may then be conveniently consulted by using the index at the end of this publication. In the appropriately headed columns opposite the name of each station are given the pages on which may be found its geographic position, description, and elevation above sea level, and the number of the detailed sketch showing the scheme of observed lines from that station.

**RELATED PUBLICATIONS.**

Engineers and other using the data given in this report for the control of maps and surveys will find it of help to have Special Publications Nos. 5, 8, and 71 of the U. S. Coast and Geodetic Survey. They may be obtained at a nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Special Publication No. 5 is entitled "Tables for a polyconic projection of maps based on Clarke's reference spheroid of 1866." This publication contains the necessary explanation of the method employed in constructing a polyconic projection, and also gives the values in meters of the degrees, minutes, and seconds of latitude and longitude for all latitudes.

Special Publication No. 8 is entitled "Formulæ and tables for the computation of geodetic positions." As the title of this publication implies, the data contained in it will enable one to compute the spherical coordinates for triangulation where the distances and angles are known.

Special Publication No. 71 is entitled "Relation between plane rectangular coordinates and geographic positions." This book contains tables which will facilitate the use by engineers of plane coordinates for local surveys.

The principal lists of geographic positions published on the North American datum throughout the United States, together with descriptions of stations, are contained in the following publications of the U. S. Coast and Geodetic Survey and of other organizations:

Appendix 8 of the Report for 1888, positions in Connecticut.

Appendix 8 of the Report for 1893, positions in Pennsylvania, Delaware, and Maryland.

Appendix 6 of the Report for 1901, positions and descriptions in Kansas and Nebraska.

Appendix 4 of the Report for 1903, positions and descriptions in Kansas, Oklahoma, and Texas.

Appendix 9 of the Report for 1904, positions and descriptions in California.

Appendix 5 of the Report for 1905, positions and descriptions in Texas.

Appendix 3 of the Report for 1907, positions and descriptions in California.

Appendix 5 of the Report for 1910, positions and descriptions in California.

Appendix 4 of the Report for 1911, positions and descriptions in Nebraska, Minnesota, North Dakota, and South Dakota.

Appendix 5 of the Report for 1911, positions and descriptions in Texas.

Appendix 6 of the Report for 1911, positions and descriptions in Florida.

Special Publication No. 11, positions and descriptions in Texas, New Mexico, Arizona, and California.

Special Publication No. 13, positions and descriptions in California, Oregon, and Washington.

Special Publication No. 16, positions and descriptions in Florida.

Special Publication No. 17, positions and descriptions in Texas.

Special Publication No. 19, positions and descriptions in Colorado, Utah, Nevada, Wyoming, Montana, South Dakota, and North Dakota.

Special Publication No. 24, positions and descriptions in Alabama and Mississippi.

Special Publication No. 30, positions and descriptions in West Virginia, Ohio, Kentucky, Indiana, Illinois, and Missouri.

Special Publication No. 31, positions and descriptions in Oregon, Washington, and California.

Special Publication No. 43, positions in Georgia.

Special Publication No. 45, descriptions in Georgia.

Special Publication No. 46, positions and descriptions in Maine.

Special Publication No. 54, positions and descriptions in Texas.

Special Publication No. 62, positions and descriptions in Rhode Island.

Special Publication No. 70, positions and descriptions in Kansas.

Special Publication No. 74, positions and descriptions in Idaho, Oregon, and Washington.

Special Publication No. 76, positions and descriptions in Massachusetts.

Special Publication No. 78, positions and descriptions in Texas (Rio Grande area).

Special Publication No. 79, positions and descriptions in Indiana.

Report on triangulation of Greater New York.

Progress report on a plan of sewerage for the city of Cincinnati.

Appendix EEE, pages 2905-3031, Annual Report of the Chief of Engineers, U. S. Army, 1902, positions of points on and near the Great Lakes.

Professional Paper No. 24, Corps of Engineers, U. S. Army, descriptions of points on and near the Great Lakes.

Publications of the Massachusetts Commission on Waterways and Public Lands.

Various bulletins of the United States Geological Survey.

*Geographic positions.*

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points.</i>							
Mount Helena, 1876..	38 40 11.080 122 37 57.817	245 56 18.019 324 01 34.823 268 20 15.615	67 22 03.416 144 28 18.913 90 58 57.203	Mount Lola... Mount Diablo... Round Top...	5.33015644 5.03233246 5.3600267	213873.23 107728.96 229100.84	701682.4 353440.8 751641.7
Marysville Butte, 1876.	39 12 22.361 121 49 11.540	50 03 28.78 103 30 30.51	229 32 49.63 282 54 51.87	Mount Helena Snow Mountain west.	4.9650596 4.9197549	92269.81 83129.44	302721.9 272733.8
Snow Mountain west, 1892.	39 22 38.452 122 45 28.619	352 06 02.01 18 03 03.98	172 10 45.86 197 49 28.49	Mount Helena Ross Mountain.	4.8992657 5.0073412	70298.64 101704.73	260165.6 333876.3
Snow Mountain east, 1876.	39 23 02.008 122 45 04.847	283 29 49.08 352 34 48.70 38 04 15.69	104 05 12.82 172 39 17.60 218 04 00.61	Marysville Butte. Mount Helena Snow Mountain west.	4.9177231 4.9027792 2.9650888	82741.44 70942.78 922.76	271460.9 262278.9 3027.4
Kent, 1904.....	39 58 01.752 122 44 14.449	316 41 36.16 1 04 01.62	137 16 41.00 181 03 29.44	Marysville Butte. Snow Mountain east.	5.0627330 4.8113645	115540.16 64768.60	379068.0 212495.0
Lyons, 1904.....	40 18 06.101 121 38 21.007	7 18 50.85 43 24 27.26	187 11 54.82 222 41 41.92	Marysville Butte. Snow Mountain east.	5.0885296 5.1444074	122611.05 139446.43	402266.4 457500.5
Bally, 1904.....	40 36 11.939 122 39 00.370	291 00 16.70 6 01 26.68	111 39 38.03 188 58 03.60	Lyons..... Kent.....	4.9640936 4.8514233	92064.79 71026.97	302049.2 233027.6
Round, 1904.....	40 48 19.882 121 57 26.873	334 10 02.02 35 40 46.89	154 22 27.03 215 10 27.70	Lyons..... Kent.....	4.7931190 5.0578276	62103.91 112424.48	203752.6 374810.5
Spur, 1904.....	41 24 14.648 122 14 54.491	339 42 45.15 20 56 17.28	159 54 13.91 200 40 28.60	Round..... Bally.....	4.8501774 4.9783111	70823.50 95128.60	232360.1 312101.1
Mears, 1904.....	41 07 29.538 122 26 52.260	208 15 08.51 310 30 15.44	28 23 01.90 130 49 32.84	Spur..... Round.....	4.5468137 4.7357813	35221.98 54422.85	115557.4 178552.3
Boliver (Calif.), 1904.	41 15 35.575 122 46 46.811	250 01 14.88 298 11 54.84	70 22 17.82 188 25 01.56	Spur..... Mears.....	4.6745307 4.4993831	47264.02 31618.27	155065.4 103734.3
Soda (Oreg.), 1904...	42 03 54.670 122 28 41.648	345 19 52.95 15 46 47.39	165 29 03.58 195 34 46.02	Spur..... Boliver.....	4.5468137 4.9680058	3216.97 60376.39	3216.97 198084.9
Gazelle astronomic station, 1904.	41 31 36.248 122 31 08.281	183 13 35.19 300 59 40.18	3 15 12.92 121 10 24.99	Soda..... Spur.....	4.7774286 4.4213899	59000.25 20386.99	196522.7 86571.3
Sterling (Oreg.), 1904.	42 01 03.864 122 53 11.434	261 00 09.26 321 51 54.19	81 16 33.53 142 17 22.56	Soda..... Spur.....	4.5341916 4.9365221	34213.03 86401.66	112247.2 283489.4
Rust, 1904.....	42 37 10.930 122 20 50.147	9 58 58.92 33 47 58.14	189 53 41.33 213 28 11.14	Soda..... Sterling.....	4.7961114 4.9046802	62533.30 80283.46	205161.3 263429.5
Onion, 1904.....	42 41 31.762 123 13 46.921	276 02 52.70 318 07 09.53	96 38 45.29 138 37 33.00	Rust..... Soda.....	4.8621488 4.9692721	72802.92 93169.15	238854.2 305672.4
Black, 1904.....	43 09 37.503 122 27 48.236	350 59 07.43 50 31 05.83	171 03 51.98 229 59 46.98	Rust..... Onion.....	4.9034795 4.9104227	80071.78 81362.20	262702.2 266935.8

## Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points—Continued.</i>							
White, 1904.....	43 07 14.428 123 02 14.761	264 24 10.96 314 23 02.31 18 19 13.10	84 47 44.04 134 51 12.74 198 11 21.87	Black..... Rust..... Onion.....	4.6712655 4.8989012 4.7000681	46910.01 79232.11 50126.59	153903.9 259947.3 164457.0
Scott, 1904.....	43 22 21.758 123 03 50.517	295 36 15.65 355 34 45.07	116 00 57.87 175 35 50.67	Black..... White.....	4.7337520 4.4484509	54169.15 28083.48	177720.0 92137.2
Fairview, 1904.....	43 35 10.459 122 39 08.622	341 59 37.72 31 14 40.80 54 40 43.54	162 07 24.98 210 58 49.21 234 23 43.86	Black..... White..... Scott.....	4.6965851 4.7811331 4.6116108	49726.19 60413.38 40889.41	163143.3 182026.3 134151.3
Yellow, 1904.....	43 32 48.849 123 24 09.568	265 37 03.17 305 06 41.39 327 50 53.15	86 08 04.66 125 20 39.92 148 05 55.44	Fairview..... Scott..... White.....	4.7836960 4.5256926 4.7470519	60770.94 32550.08 55853.69	199379.3 110072.2 183246.6
Spencer, 1903.....	43 59 00.715 123 05 41.248	320 57 05.87 27 10 28.02	141 15 27.90 206 57 41.38	Fairview..... Yellow.....	4.7537056 4.7362230	56716.00 54479.49	186075.7 178738.1
Roman, 1903.....	43 54 45.041 123 44 14.987	261 04 53.49 292 09 05.10 326 17 38.82	81 31 39.25 112 54 06.43 146 31 32.08	Spencer..... Fairview..... Yellow.....	4.7176307 4.9759767 4.6880983	52195.22 94618.63 48763.89	171243.8 310428.0 159986.2
Mary, 1903.....	44 30 17.369 123 33 05.732	327 37 54.62 12 47 13.03	147 57 02.02 192 39 26.37	Spencer..... Roman.....	4.8354276 4.8201199	68458.53 67471.43	224601.0 221362.5
Peterson, 1903.....	44 30 38.293 122 58 05.537	9 50 19.67 43 02 28.28 89 24 24.75	189 45 01.69 222 30 17.06 238 59 52.49	Spencer..... Roman..... Mary.....	4.7740504 4.9568321 4.6664822	59436.11 90538.25 46396.18	195000.0 297040.9 152218.1
Twin, 1905.....	44 19 31.401 123 00 11.426	10 57 11.34 52 17 07.57 114 43 37.75	190 53 21.59 231 46 27.22 294 20 36.03	Spencer..... Roman..... Mary.....	4.5875519 4.8725285 4.6813809	38685.83 74563.88 48015.44	126921.8 244631.7 157530.7
Ridge, 1905.....	44 16 02.051 123 19 55.940	146 33 52.16 228 52 25.20 256 03 38.80	326 24 39.71 47 07 41.87 76 17 26.03	Spencer..... Peterson..... Twin.....	4.3174815 4.5983320 4.4320513	20772.15 39658.11 27042.78	68150.0 130111.6 88722.9
Rauch, 1903.....	44 00 50.965 123 19 42.158	179 22 37.92 207 24 34.93 216 50 01.62	359 22 28.32 27 39 39.91 37 03 37.36	Ridge..... Peterson..... Twin.....	4.4490510 4.7938886 4.6362034	28122.31 62214.04 43271.64	92264.6 204114.0 141967.0
Willamette south base, 1903.	44 04 06.905 123 11 17.933	61 14 15.53 149 14 18.50 152 30 46.78	241 38 25.01 50 328 59 05.33 332 24 45.86	Rauch..... Mary..... Ridge.....	4.1055673 4.7519303 4.3960802	12751.68 56484.64 24893.17	41836.1 185316.7 81670.3
Willamette north base, 1905.	44 11 37.076 123 12 41.921	25 09 09.08 130 22 30.94 228 35 55.72	205 04 16.61 310 17 28.19 48 44 39.50	Ridge..... Twin..... Spencer.....	4.3428910 4.1016178 4.3457607	22023.74 12636.24 22169.74	72256.2 41457.4 72735.2
Seavies 2, 1908.....	44 06 24.663 123 00 09.593	28 21 03.50 74 06 22.54	208 17 12.93 253 58 37.54	Spencer..... Willa mette south base.	4.1921494 4.1893425	15565.01 15464.74	51066.2 50737.2
Pisgah, 1908.....	44 00 19.836 122 57 51.568	76 54 39.61 111 24 00.79	256 49 13.38 291 14 40.27	Spencer..... Willa mette south base.	4.0312723 4.2849731	10746.63 19274.05	35257.9 63234.9
Eugene astronomic station, 1894.	44 03 30.319 123 05 28.438	232 47 15.95 299 58 45.95	52 50 57.77 120 04 00.50	Seavies 2..... Pisgah..... Spencer.....	3.9495852 4.0700458 3.9204384	8904.00 11750.21 8326.04	29212.5 38550.5 27316.3
Yam, 1903.....	45 03 44.993 123 08 34.292	347 14 12.38 27 42 30.71	167 21 35.33 207 25 14.16	Peterson..... Mary.....	4.7984079 4.8445219	62864.86 69907.19	202649.1 229353.8

## Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points—Continued.</i>							
Hult, 1903.....	44 57 48.151 122 42 45.524	22 00 26.60 108 08 46.40	201 49 39.13 287 50 31.00	Peterson..... Mary..... Yam.....	4.7342429 4.9229453 4.5516119	54230.41 83742.39 35658.40	177920.9 274744.8 116089.3
Barnes (Oreg.), 1903.	45 31 36.526 122 45 00.031	357 18 16.35 30 59 06.87	177 19 51.87 210 42 21.69	Hult..... Yam.....	4.7971754 4.7789013	62686.70 60103.71	205664.6 197190.3
Larch (Oreg.), 1903..	45 31 59.615 122 05 13.018	38 01 16.39 58 05 53.27	217 34 36.71 237 20 51.35	Hult..... Yam..... Barnes.....	4.9038918 4.9910591 4.7143490	80147.83 97962.33 51802.18	262851.7 321398.1 169054.3
Star (Wash.), 1906...	45 44 47.711 122 14 16.246	333 33 31.93 58 43 49.19	153 40 00.32 238 21 51.02	Larch..... Barnes.....	4.4227804 4.6703557	26471.61 46811.34	86348.9 133581.8
Davis (Wash.), 1906.	45 55 37.452 122 35 44.667	314 32 26.39 134 07 37.13	134 47 51.18 192 50 25.25	Star..... Barnes.....	4.5918994 4.7264533	39075.00 53266.40	128198.6 174758.2
Red (Wash.), 1906...	45 56 07.249 121 49 12.344	25 01 17.31 57 16 07.55	204 49 39.37 236 58 08.64	Larch..... Star..... Davis.....	4.6927096 4.5870098 4.7815631	49284.42 38844.78 60473.22	161694.0 126787.1 198402.6
Warren (Oreg.), 1903	45 48 33.229 122 52 08.679	225 52 07.84 296 26 15.40	46 03 54.50 116 59 49.58	Davis..... Larch..... Barnes.....	4.4698843 4.8339771 4.5149889	29504.23 68230.27 32731.73	96798.5 223852.1 107387.3
Lam, 1906.....	46 07 57.903 122 27 42.295	293 35 59.64 33 54 34.32	114 03 42.24 213 48 46.96	Red..... Davis.....	4.7348430 4.2600393	54305.40 18607.75	178167.0 61048.9
Len, 1906.....	46 18 45.173 122 08 00.508	329 52 16.76 45 23 14.48	150 05 49.99 123 04 19.29	Red..... Davis..... Lam.....	4.6850313 4.7016486 4.5087061	48420.72 50309.34 32263.10	158860.3 165056.6 105849.9
Toutle, 1905.....	46 17 10.419 122 33 02.971	264 39 01.27 338 01 14.03	171 58 05.52 158 06 05.52	Len..... Lam..... Davis.....	4.5009454 4.2644630 4.5149954	32288.32 18392.59 32986.06	105932.6 60343.0 107270.3
Huck, 1905.....	46 42 45.136 122 26 04.593	332 25 33.37 10 42 13.91	152 38 39.90 190 37 10.43	Len..... Toutle.....	4.6999316 4.6823291	50110.83 48221.32	164405.3 158206.1
Bel, 1905.....	46 47 04.983 121 56 22.841	15 52 53.95 40 27 22.81	195 44 27.47 220 00 45.94	Len..... Toutle..... Huck.....	4.7368025 4.8084866 4.5872792	54550.97 72585.28 38661.55	178972.6 238140.2 126842.1
Hal, 1905.....	46 43 52.344 122 27 08.201	261 10 35.73 326 55 58.87	81 33 00.02 146 56 45.18	Bel..... Huck.....	4.5978304 3.3937882	39012.33 2476.21	129961.5 8124.0
Rain, 1905.....	46 50 07.065 122 41 09.422	275 21 54.89 302 52 33.79	95 54 33.66 123 02 46.85	Bel..... Hal..... Huck.....	4.7576825 4.3277211 4.3720505	57237.74 21267.75 23553.23	187787.5 69775.9 77274.2
Hurst, 1905.....	47 05 02.549 122 30 44.966	307 07 42.31 351 47 38.64	127 32 48.86 171 51 03.36	Bel..... Huck.....	4.7392818 4.6203825	54863.28 41723.67	179997.3 136888.4
		353 18 25.73	173 21 04.03	Hal.....	4.5965035	39491.49	129565.0
		23 35 08.72	205 27 32.32	Rain.....	4.4863335	30643.15	100535.1
Pen, 1905.....	47 02 05.064 122 17 11.732	20 34 48.68 54 03 04.74	200 27 33.28 233 45 34.39	Hal..... Rain.....	4.5566543 4.5759955	36029.17 37635.66	118205.7 123476.3
		107 47 37.81	287 37 42.47	Hurst.....	4.2556667	18016.34	108321.7
Tacoma south base, 1905.	47 04 38.837 122 26 05.422	292 48 20.30 1 59 00.26	112 54 50.97 181 58 14.43	Pen..... Hal..... Rain..... Hurst.....	4.0872032 4.5856276 4.5187312 3.7739023	12223.72 38514.80 33016.51 5942.41	40104.0 126360.6 108321.7 19494.1
Tacoma north base, 1905.	47 11 09.180 122 25 58.206	326 29 52.90 0 43 24.61	146 36 18.63 180 43 19.32	Pen..... Tacoma south base..... Hurst.....	4.3040283 4.0811877 4.7038770 4.6381786 4.1083677	20138.56 12055.570 50568.14 43468.90 12834.17	66071.3 39552.32 165905.6 142614.1 42106.8
		1 41 03.08	181 40 11.93	Hal.....	4.7038770	50568.14	
		26 22 29.54	206 11 23.00	Rain.....	4.6381786	43468.90	
		28 07 11.39	208 03 41.21	Hurst.....	4.1083677	12834.17	

## Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Principal points—Continued.</i>							
Burn, 1905.....	47 13 50.673 122 29 43.555	316 25 07.53 323 54 06.60 344 53 16.94	136 27 52.88 144 03 16.62 164 55 56.96	Tacoma north base. Pen..... Tacoma south base. Hurst.....	3.8376905 4.4304238 4.2467477	6881.62 26941.63 17650.12	22577.4 88391.0 57907.1
		4 32 34.29	184 31 49.25	Burn.....	4.2137976	16360.54	53676.2
Kin, 1905.....	47 14 02.319 122 24 57.219	13 30 16.14 86 36 43.07	103 29 31.38 266 33 12.88	Tacoma north base. Burn.....	3.7402404 3.7805720	5498.45 6033.54	18039.5 19795.0
Wash, 1905.....	47 16 14.306 122 29 04.374	308 06 03.35 337 25 01.77	128 09 04.85 157 27 18.42	Kin..... Tacoma north base. Burn.....	3.8199767 4.0068869	6606.58 10206.74	21675.1 33486.6
		10 30 52.80	190 30 24.04	Burn.....	3.6545858	4514.25	14810.5
Bos, 1905.....	47 15 59.493 122 23 01.509	23 54 32.01 93 29 27.78	213 53 07.11 273 25 01.31	Kin..... Wash.....	3.6394393 3.8830851	4359.53 7639.85	14302.9 25065.1
Gull, 1891.....	47 17 52.574 122 25 54.219	313 53 29.85 350 25 44.00	133 55 36.67 170 26 25.88	Bos..... Kin..... Wash.....	3.7020410 3.8579978 3.7003670	5035.48 7211.04 5016.11	16520.6 22658.2 16457.0
Dron, 1905.....	47 18 00.812 122 26 28.511	310 43 39.16 345 23 08.48	130 46 11.18 165 24 16.54	Bos..... Kin..... Wash.....	3.7588960 3.8814482 3.6665016	5739.79 7611.11 4639.82	18831.3 24970.8 15222.5
Spalt, 1905.....	47 17 46.283 122 31 28.575	265 53 53.35 313 06 11.23	85 57 33.87 133 07 57.18	Dron..... Wash.....	3.8007266 3.6182138	6320.14 4151.58	20735.3 13620.6
Nelli 2, 1905.....	47 19 55.014 122 29 28.963	312 55 19.83 355 39 41.56	132 57 32.48 175 39 59.63	Dron..... Wash..... Smelt.....	3.7140633 3.8345920 3.6723549	5177.06 6832.69 4702.78	16965.1 22416.9 15429.0
Tacoma astronomic station, 1892.	47 15 47.911 122 26 51.446	156 34 15.80 197 20 35.49	336 32 20.05 17 21 17.53	Neill 2..... Gull.....	3.9200079 3.6056668	8317.79 4033.36	27289.3 13232.8
<i>Supplementary points.</i>							
Mount St. John, 1904	39 26 03.17 122 41 32.14	176 16 31 288 19 10	356 14 48 108 52 20	Kent..... Marysville..... Butte.	4.773030 4.809689	59296.6 79376.0	194542 260419
Corning tower, 1904	39 55 40.774 122 10 44.008	95 23 05.04 227 46 57.18	275 01 34.16 48 07 49.11	Kent..... Lyons..... Marysville..... Butte.	4.6805528 4.7921037 4.9338347	47923.97 61958.90 85988.67	157230.6 203276.8 281720.8
Corning astronomic station, 1908.	39 55 40.48 122 10 44.92	247 24 10	67 24 11	Corning tower.	1.36933	23.41	76.8
Mount Linn, top of peak, 1904.	40 02 12.617 122 51 11.855	195 17 14.5 253 44 09.8	15 25 07.8 74 31 09.3	Bally..... Lyons..... Marysville..... Butte.	4.814440 5.031505 5.107132	65228.9 107523.9 127977.0	214005 352768 419871
Lassen Peak, 1904	40 29 18.614 121 30 15.513	10 50 33.3 28 56 28.7 61 31 03.3	190 38 25.4 208 51 14.1 240 43 16.5	Marysville..... Butte. Lyons..... Kent.....	5.161103 4.374630 5.078644	144911.5 23693.5 119851.7	475430 77734 393213
Bully Choop, 1904	40 33 20.346 122 45 58.884	241 41 39.9 286 03 36.6 357 49 40.2	61 46 12.1 106 47 28.1 177 50 47.7	Bally..... Lyons..... Kent.....	4.048286 4.998792 4.815526	11176.0 99722.2 65392.2	36667 327172 214541
Redding courthouse, 1908.	40 34 58.278 122 23 44.281	96 06 13.3 236 07 45.1	275 56 17.2 56 24 53.6	Bally..... Round.....	4.335680 4.648670	21661.1 44531.8	71066 146101
Redding astronomic station, 1904.	40 34 19.354 122 23 38.684	99 11 08.7 173 44 41.4	279 01 09.1 353 44 37.8	Bally..... Redding court house. Round.....	4.341461 3.082013 4.654218	21951.3 1207.8 45104.3	72019 3963 147980

<sup>1</sup> Checked by vertical angles only.

## Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Supplementary points—Continued.</i>							
Redding south base, 1908.	40 34 28.152 122 23 24.911	50 02 58.9 91 29 00.2 153 53 14.2	230 02 49.9 271 28 50.5 333 53 01.6	Redding astronomic station. Hill..... Redding courthouse.	2.625930 2.545762 3.014915	422.6 351.4 1034.9	1386 1153 3395
Redding north base, 1908.	40 34 42.167 122 23 27.340	352 28 22.7 20 46 04.0 34 47 58.0 141 17 01.8	172 28 24.2 200 45 56.6 214 47 49.9 321 16 50.8	Redding south base. Redding astronomic station. Hill..... Redding courthouse.	2.639542 2.876541 2.712126 2.804122	436.1 752.6 515.4 637.0	1431 2469 1691 2090
Hill, 1908.....	40 34 28.446 122 23 39.845	354 26 27.4 173 31 58.0	174 26 28.2 353 31 55.1	Redding astronomic station. Redding courthouse.	2.449913 2.966656	281.8 926.1	925 3038
Crater Peak, 1904.....	40 41 54.374 121 37 05.274	2 19 29.9 83 26 10.3 124 23 11.6	182 18 40.7 262 45 50.1 303 50 35.4	Lyons..... Bally..... Mears.....	4.644353 4.944089 4.926513	44091.3 87920.3 84433.2	144656 288452 277011
Thompson Peak, 1904. <sup>1</sup>	40 56 37.67 122 52 19.33	225 27 58 240 26 59	45 52 36 60 43 42	Spur..... Mears.....	4.864213 4.612243	73149.8 40949.0	230992 134347
Saw Tooth, 1904.....	40 58 21.995 123 00 05.396	232 35 06.1 249 52 27.8 324 01 15.2	53 04 51.4 70 14 16.7 144 15 01.6	Spur..... Mears..... Bally.....	4.899168 4.694762 4.704374	79280.8 49517.9 50626.0	26010 162460 166095
Mount Eddy, cairn, 1904.	41 19 12.449 122 28 42.470	75 14 54.3 180 00 47.0 244 04 37.5	255 02 58.9 00 47.6 64 13 44.6	Boliver..... Soda..... Spur.....	4.416695 4.917772 4.330090	26103.3 87250.8 21384.1	85641 271492 70158
Black Butte, cairn, 1904.	41 22 00.307 122 20 49.936	148 20 23.9 141 07 26.9	327 58 52.5 321 00 37.6	Sterling..... Gazelle astronomic station.	4.929970 4.358721	85107.9 22841.3	279225 749398
		243 19 08.0 172 02 30.6	63 23 03.0 351 57 16.6	Spur..... Soda.....	3.965684 4.893957	9240.3 78335.2	30316 257005
Mount Shasta, top, 1904.	41 24 33.797 122 11 38.482	343 25 01.5 23 21 05.6 34 01 48.5 71 28 59.0 139 46 03.1 162 06 35.9	163 34 21.4 203 03 08.3 213 51 45.8 251 05 46.5 319 18 24.3 341 55 14.8	Round..... Bally..... Mears..... Boliver..... Sterling..... Soda.....	4.844749 4.988525 4.580807 4.713995 4.948444 4.884108	69043.8 73792.4 38089.6 51760.1 88806.4 76578.7	229474 319528 124966 169816 291359 251242
China Mountain, not the cairn, 1904.	41 22 41.420 122 34 31.102	4 12 29.0 52 33 09.7 186 00 38.1 263 53 09.2	184 09 32.3 232 25 03.9 6 04 30.6 84 06 07.2	Bally..... Boliver..... Soda..... Spur.....	4.935906 4.333907 4.884968 4.439125	86279.2 21572.8 76730.5 27486.9	283068 70777 251740 90130
Russian Peak, north point, 1904.	41 16 59.106 122 57 03.164	133 44 19.2 256 53 40.8 280 07 36.0	3 46 53.2 77 21 31.2 100 14 22.5	Sterling..... Spur..... Boliver.....	4.912596 4.780366 4.163622	81770.4 60306.8 14575.5	268275 197857 47820
Russian Peak, south point, 1904. <sup>2</sup>	41 16 58.70 122 57 03.24	258 53 00 292 25 38	77 20 51 112 45 31	Spur..... Mears.....	4.780398 4.659934	60311.2 45701.9	197871 149940
Marble Mountain, 1904.	41 34 46.625 123 05 27.947	199 11 35.3 223 09 00.2 285 12 26.0	19 19 46.2 43 33 31.4 105 45 55.8	Sterling..... Soda..... Spur.....	4.712199 4.870229 4.863427	51546.5 74170.1 73017.5	160115 243340 239558
Little Shasta, 1904...	41 43 14.240 122 13 18.490	42 30 04.4 121 00 02.3 151 00 27.3	222 07 53.9 300 39 25.2 330 50 10.8	Boliver..... Sterling..... Soda.....	4.840115 4.808209 4.641374	69201.4 64299.7 43789.9	227038 210957 143667

<sup>1</sup> Checked by vertical angles only.<sup>2</sup> No check on this position.

## Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Supplementary points—Continued.</i>							
Goose Nest, tall tree (Cal.), 1904.	41 48 58.928 122 14 19.005	36 03 58.7 251 08 55	215 52 42.6 215 58 13.8	Gazelle astrometric station.	4.509314	39747.9	130406
		36 19 45.5 144 21 42.8 112 48 33.3	215 58 13.8 324 12 06.2 292 22 35.1	Boliver..... Soda..... Sterling.....	4.883890 4.531977 4.765654	76540.3 34039.0 58217.6	251116 111676 191002
Preston Peak (Cal.), 1904.	41 50 07.93 123 36 39.82	198 10 15 251 08 55	18 25 38 71 37 58	Onion..... Sterling.....	5.000947 4.802197	100218.3 63415.7	328800 208056
Greyback (Oreg.), 1904.	42 06 37.101 123 18 41.721	185 55 39.3 210 31 32.8 286 08 49.7	5 58 58.1 31 06 01.1 106 25 54.9	Onion..... Black..... Sterling.....	4.812796 5.132066 4.564137	64982.4 135820.7 36655.3	213196 445605 120260
Pilot Rock, 1904.....	42 01 51.653 122 33 36.073	12 08 01.3 86 50 17.2 240 41 59.1 339 28 26.6	191 59 15.8 286 46 10.4 60 45 16.4 159 40 53.0	Boliver..... Sterling..... Soda..... Spur.....	4.942399 4.432656 3.889986 4.871003	87578.8 27080.5 7762.2 74302.4	287331 88847 25466 243774
Siskiyou, 1904 <sup>1</sup> .....	42 03 44.11 122 45 49.09	151 24 26 269 08 50	331 05 25 89 18 18	Onion..... Soda.....	4.902040 4.378372	79908.8 23825.0	261933 77510
Kerby, 1904 <sup>1</sup> .....	42 13 14.81 123 27 35.84	199 49 51 245 48 38	19 09 12 64 33 41	Onion..... Rust.....	4.745767 5.007567	55688.7 101757.6	182705 333850
Ashland Peak, cairn, 1904	42 04 52.547 122 42 57.867	148 14 12.4 206 48 39.6 275 06 14.9 332 29 50.9 8 20 37.4	327 53 25.9 207 33 04.1 95 15 48.7 152 48 31.8 183 18 06.3	Onion..... Rust..... Soda..... Spur..... Boliver.....	4.902873 4.826635 4.266873 4.927763 4.960854	79908.0 67098.5 19763.9 84676.5 91380.6	262235 220100 64842 277809 209805
Wagner, 1904.....	42 07 05.737 122 46 24.237	149 38 40.8 192 16 58.1 212 04 35.7 283 28 19.0	320 20 13.1 12 29 34.1 32 21 49.6 103 40 11.4	Onion..... Black..... Rust..... Soda.....	4.869186 5.073816 4.818477 4.400065	73992.2 118526.6 65838.1 25122.6	242756 388866 216004 82423
Aspen Peak, 1904.....	42 18 57.286 122 05 12.427	49 23 40.7 114 22 07.9 147 40 45.0	220 07 54.2 293 35 47.8 337 30 11.8	Soda..... Onion..... Rust.....	4.630179 5.012074 4.601743	42675.5 102819.1 39970.8	140011 337332 131138
Mount Pitt, 1904.....	42 26 41.964 122 18 54.365	17 45 18.0 110 28 28.0 171 22 17.4 172 15 27.2	197 33 25.2 289 46 20.7 351 16 14.7 352 14 09.0	Soda..... Onion..... Black..... Rust.....	4.646239 4.902673 4.905232 4.291959	44283.2 79908.0 80395.6 19586.5	145296 262235 263765 64260
Lost Peak, 1904 <sup>1</sup> ....	42 30 50.92 122 08 42.90	102 53 37 125 19 26	282 09 35 305 11 14	Onion..... Rust.....	4.959834 4.807793	91166.2 20313.9	299101 66647.
Central Point astrometric station, 1904.	42 23 51.581 122 56 23.451	242 56 29.8 313 56 45.8	63 20 31.3 134 15 22.8	Rust..... Soda.....	4.7371413 4.7248137	54503.6 53065.7	179113 174100
Central Point latitude station, 1904.	42 23 51.512 122 56 23.265	116 41	296 41	Central Point astrometric station.	0.6785	4.77	15.6
Union Peak, 1903.....	42 49 53.546 122 13 21.078	23 30 40.6 79 42 19.8 157 31 38.4	203 25 35.9 259 01 18.0 337 13 58.9	Rust..... Onion..... Fairview.....	4.409163 4.923680 4.958228	25654.5 83895.9 90829.7	84168 275216 297997
Mount Scott, 1904....	42 55 24.019 122 00 55.849	36 57 11.5 75 54 57.5 105 05 45.2 125 57 47.4	218 43 40.3 255 06 26.9 284 30 10.1 305 39 26.7	Rust..... Onion..... White..... Black.....	4.636686 5.011101 4.864805 4.653341	43304.8 102589.1 73249.6 45013.3	142076 336578 240320 147681
Lia Rock, 1904.....	42 57 08.066 122 10 06.336	21 40 13.7 71 58 52.6 105 05 45.2 124 00 04.6 151 00 38.6	201 22 56.4 251 13 35.6 284 30 10.1 318 49 59.6 330 40 44.3	Rust..... Onion..... White..... Black..... Fairview.....	4.599165 4.961284 4.864805 4.528112 4.906616	39734.3 91471.1 73249.6 33381.2 80652.2	130362 300101 240320 100490 244600
High Rock, 1904....	43 03 02.980 122 29 05.870	99 58 29.9 188 10 33.3 346 43 45.8	279 35 51.2 8 11 26.2 166 49 23.7	White..... Black..... Rust.....	4.659501 4.089936 4.691934	45656.3 12300.9 49196.5	149791 40357 161406

<sup>1</sup> No check on this position.

97454°—22—3

## Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Supplementary points—Continued.</i>							
Old Bailey, 1904.....	43 09 19.966 122 13 09.098	58 22 56.4 86 56 58.3 91 38 41.9 143 52 40.2	237 41 39.0 266 23 24.2 271 28 40.6 322 34 49.3	Onion..... White..... Black..... Fairview.....	4.967860 4.824026 4.298188 4.773418	97243.4 66684.7 19860.5 50349.6	319099 218781 65189 194716
Walker Peak, 1904 <sup>1</sup> ..	43 11 33.68 122 02 18.18	84 18 22 131 31 15	265 55 55 311 05 56	Black..... Fairview.....	4.540688 4.821076	34743.1 66238.1	113696 217300
Dodson (U. S. G. S.), 1904.	43 07 10.136 123 14 35.150	127 39 24.7 207 16 30.9 269 28 35.0	307 36 20.1 27 23 52.6 89 37 01.2	Burg..... Scott..... White.....	3.886832 4.500640 4.223711	7706.1 31660.4 16783.3	25283 103902 54916
Rose, 1904.....	43 14 09.038 123 19 18.555	233 53 46.81 298 51 36.64 119 03 17.19	54 04 28.33 110 09 34.93	Scott..... White.....	4.41262323 4.42204063	25850.68 26426.56	84841.3 86701.56
Burg, 1904.....	43 09 42.607 123 19 05.198	177 54 02.44 221 16 38.67 281 13 40.24	357 53 53.30 41 27 05.61 101 25 11.18	Rose..... Scott..... White.....	3.91526097 4.4943632 4.3671347	8227.53 31214.99 23288.13	26993.2 102411.2 76404.5
Roseburg latitude station, 1904.	43 12 40.766 123 21 13.849	223 40 38.71 332 08 06.89	43 41 57.67 152 09 34.93	Rose..... Burg.....	3.5756994 3.70936002	3767.03 6218.42	12350.0 20401.6
Quartz, 1904.....	43 09 51.770 122 40 14.595	80 52 53.4 181 48 31.6 271 25 29.2	260 37 50.6 1 49 16.9 91 33 59.7	White..... Fairview..... Black.....	4.490385 4.671093 4.227036	30226.3 46891.4 16866.9	99167 153843 55337
Diamond Peak, 1904.	43 31 16.014 122 08 54.650	32 36 47.1 100 14 59.1 124 18 40.2	212 23 49.1 279 54 09.2 309 39 24.4	Black..... Fairview..... Roman..... Spencer.....	4.676843 4.61625 5.131086 4.963218	47516.3 41354.7 135233.7 91913.4	155803 135678 443679 301553
Mount Zion, 1903 <sup>1</sup> ...	43 47 29.576 122 43 24.335	90 42 38.7 125 41 05.6	279 00 29.5 306 25 38.8	Roman..... Spencer.....	4.917183 4.504457	82638.6 36682.3	271123 120349
Russian Church, cross, 1908.	44 03 18.487 123 10 36.088	148 04 20.1 247 32 11.5 287 52 19.2 320 26 05.3	328 03 51.0 67 39 27.3 108 01 18.6 140 29 30.3	Willamette south base..... Seavies 2..... Pisgah..... Spencer.....	3.245722 4.178324 4.263746 4.013515	1760.8 15077.3 17895.6 10316.1	5777 49466 58712 33845
Springfield, Methodist Church, 1908.	44 02 53.545 123 01 20.032	39 01 16.7 101 37 24.9	218 58 15.1 281 34 32.2	Spencer..... Eugene astronomic station..... Seavies 2.....	3.905968 3.751653 3.826199	9240.3 5644.9 6701.9	30326 18520 21968
Springfield, Christian Church, 1908.	44 02 51.552 123 01 11.024	40 13 27.9 101 49 52.3	220 10 10.0 281 46 43.3	Spencer..... Eugene astronomic station..... Seavies 2.....	3.906969 3.767444 3.827305	9326.1 5853.9 6719.0	30507 19206 22044
Eugene, Deady Hall, west tower, 1908.	44 02 49.475 123 04 32.924	135 34 35.0 221 23 39.0 191 43 56.5	315 33 56.4 41 26 42.1 11 44 39.2	Eugene astronomic station..... Seavies 2..... Seavies 2.....	3.246821 3.947264 3.858099	1765.3 8880.9 7222.7	5792 29058 23666
Eugene, Geary School spire, 1908.	44 03 22.161 123 06 11.803	101 29 14.4 255 22 35.7	281 25 41.5 75 23 05.8	Willamette south base..... Eugene astronomic station..... Pisgah..... Spencer.....	3.842110 2.906939 4.006223 3.906378	6052.0 997.6 12490.2 8008.0	22808 3273 40945 26568
Eugene, United Brethren Church, 1908.	44 02 53.986 123 05 02.786	105 07 28.9 153 01 50.8	285 03 08.1 333 01 33.1	Willamette south base..... Eugene astronomic station..... Seavies 2..... Pisgah.....	3.930928 3.100014 3.964328 4.030071	8648.2 1250.0 9211.4 10716.9	28373 4131 30221 35160

<sup>1</sup> No check on this position.

## Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Supplementary points—Continued.</i>	• • "	• • "	• • "				
Eugene, Patterson School spire, 1908.	44 02 47.636 123 04 46.593	9 51 58.2 144 44 27.6	169 51 20.2 324 43 58.6	Spencer..... Eugene astronomic station.	3. 861794 3. 207750	7108.8 1613.5	23323 5294
		222 35 52.0	42 38 44.7	Seavies 2.....	3. 969172	9102.7	29864
Eugene, Baptist Church spire, 1908.	44 03 05.830 123 05 19.023	103 18 42.4 104 30 00.1	263 14 32.7 344 30 02.6	Willamette south base. Eugene astronomic station.	3. 914232 2. 804500	8207.9 784.3	26029 2573
		228 15 28.8 297 10 01.0	48 19 04.1 117 15 11.9	Seavies 2..... Pisgah.....	3. 964873 4. 049392	9223.0 11204.5	30250 36760
Eugene, W. O. W. Hall spire, 1908.	44 03 05.553 123 05 46.250	207 25 20.7	27 25 42.1	Eugene astronomic station.	2. 9835103	861.2	2825
		230 36 00.7 295 46 25.7	50 40 03.9 115 51 55.6	Seavies 2..... Pisgah.....	3. 986290 4. 069796	9689.2 11743.5	31799 38528
Eugene, courthouse, flagpole, 1908.	44 03 06.273 123 06 24.041	103 23 55.9 172 29 22.8	283 19 49.7 352 29 19.7	Willamette south base. Eugene astronomic station.	3. 908272 2. 874247	8096.0 748.6	26562 2456
		228 46 41.9 296 58 08.6	48 50 20.6 117 03 23.0	Seavies 2..... Pisgah.....	3. 968374 4. 053471	9297.7 11310.2	30504 37107
Eugene, Methodist Church, 1908.	44 02 56.857 123 05 31.498	105 41 44.6 183 46 22.9	285 37 43.6 3 46 25.0	Willamette south base. Eugene astronomic station.	3. 903543 3. 014948	8008.4 1035.0	26274 3306
		• 228 07 33.9 295 16 37.7	48 11 17.8 115 21 57.2	Seavies 2..... Pisgah.....	3. 982033 4. 054279	9614.6 11331.3	31544 37176
Seavies (U. S. G. S.), 1908. <sup>1</sup>	44 06 31.970 122 50 54.656	29 01 13.7 73 39 13.6	208 57 12.7 253 31 18.2	Spencer..... Willamette south base.	4. 202007 4. 199933	15922.3 15846.5	52238 51990
Ball Butte, 1903....	43 58 47.550 121 41 15.765	60 56 47.4 88 06 26.2	240 16 44.4 266 41 05.0	Fairview..... Roman.....	4. 950000 5. 216758	88125.1 164724.4	292405 540433
		90 41 41.0	269 43 03.5	Spencer.....	5. 052670	112993.8	370386
St. Mary Butte, 1903	44 06 00.402 121 41 54.992	54 34 20.3 84 06 04.6	233 54 42.2 262 40 05.7	Fairview..... Roman.....	4. 975587 5. 216529	94538.8 164837.6	310150 540149
		84 49 15.3	263 51 01.6	Spencer.....	5. 051040	112470.9	368908
South Sister, 1903....	44 06 14.251 121 46 08.254	51 18 35.7 83 00 38.4	230 41 52.5 261 38 34.5	Fairview..... Roman.....	4. 980995 5. 202201	91410.3 169294.6	299092 522619
		83 17 08.4 115 41 46.4	262 21 45.1 264 51 30.7	Spencer..... Peterson.....	5. 029801 5. 024583	107102.8 105823.7	351386 347190
Middle Sister, 1903....	44 06 55.768 121 46 59.750	48 29 01.0 80 32 32.2	227 52 52.6 259 37 48.4	Fairview..... Spencer.....	4. 971957 5. 028044	93746.9 106870.4	307568 349968
		81 09 56.6 113 27 24.0	259 48 26.5 292 37 43.2	Roman..... Peterson.....	5. 200978 5. 011607	158846.6 102708.7	521149 336970
North Sister, 1903....	44 10 01.464 121 46 17.183	47 57 31.4 79 34 17.3	227 20 53.1 258 39 03.3	Fairview..... Spencer.....	4. 981370 5. 033231	95808.0 107952.1	314314 354173
		80 30 32.5 112 12 06.1	259 08 32.0 291 22 55.0	Roman..... Peterson.....	5. 204400 5. 011964	180108.2 102793.1	525272 337247
Nebo, 1903 <sup>1</sup> .....	44 06 27.05 122 42 05.14	356 26 48 58 38 58	176 27 50 238 20 13	Fairview..... Spencer.....	4. 803430 4. 567857	63596.0 36970.6	208848 121204
Herman Peak, wooded summit, 1903. <sup>1</sup>	44 07 29.14 124 00 43.71	220 51 52 316 51 55	41 11 10 127 03 22	Mary..... Roman.....	4. 748023 4. 506753	55978.7 32266.6	188657 105861
Prairie Peak, west tree, 1903.	44 16 42.307 123 36 28.771	14 21 17.1 190 06 28.8	194 15 52.7 10 08 50.8	Roman..... Mary.....	4. 622824 4. 407496	41958.9 25556.2	137660 88348
		308 24 09.5	128 45 35.9	Spencer.....	4. 720497	52340.8	172378

<sup>1</sup> Checked by vertical angles only.

## Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Supplementary points—Continued.</i>							
Alsea Peak, partly cleared wooded summit, 1904.	44 25 27.821 123 40 22.746	227 11 02.2 270 03 23.6 5 12 21.3	47 16 08.3 80 33 01.0 183 09 39.5	Mary..... Peterson..... Roman.....	4.110275 4.755084 4.756721	13180.6 56986.3 57111.2	43178 186667 187372
Cannibal Peak high- est wooded sum- mit 1903.	44 28 33.48 123 50 09.03	261 49 41 352 48 28	82 01 38 172 52 35	Mary..... Roman.....	4.359628 4.800029	22836.9 63099.9	74924 207020
Mount Washington, 1903.	44 19 57.346 121 50 15.638	38 32 25.7 69 20 51.5 73 35 56.4 98 34 49.1 102 47 18.1	217 58 29.8 248 28 18.8 252 16 34.7 277 22 50.5 281 59 49.4	Fairview..... Spencer..... Roman..... Mary..... Peterson.....	5.023604 5.032546 5.201576 5.139352 4.946399	105607.3 107781.9 159065.5 127832.6 92190.5	346480 353614 521967 452206 302429
Hayrick, 1903.....	44 28 46.040 121 50 31.724	33 29 07.0 61 36 02.5 65 05 14.2 91 47 12.2	212 55 19.5 240 43 36.8 246 45 57.3 270 35 19.1	Fairview..... Spencer..... Roman..... Mary.....	5.074123 5.05844 5.215083 5.132540	11810.5 114246.8 164093.3 136000.3	388441 374925 538353 446194
Left Nipple, 1903....	44 29 49.672 122 34 33.718	36 09 59.1 90 58 23.5 92 54 31.7 144 40 08.0	215 48 15.8 270 17 21.8 272 37 01.5 324 16 10.6	Spencer..... Mary..... Peterson..... Yam.....	4.848359 4.888812 4.404486 4.887624	70527.6 77601.1 31228.8 77201.2	281399 264863 103440 323284
Lebanon, tall brick chimney, 1903 <sup>1</sup> .	44 32 58.43 122 54 14.18	49 46 03 84 42 42	229 43 21 264 15 27	Peterson..... Mary.....	3.825683 4.713097	6694.0 51724.6	21962 169700
Corvallis closed cu- pola, 1903 <sup>1</sup> .	44 33 59.92 123 16 23.92	284 17 14 72 50 39	104 30 04 262 38 56	Peterson..... Mary.....	4.398558 4.304764	25035.6 23166.8	82138 75987
Corvallis open cupola, 1903 <sup>1</sup> .	44 33 55.89 123 16 46.16	283 44 22 72 46 27	103 57 28 252 35 00	Peterson..... Mary.....	4.406228 4.355167	25481.7 23655.2	83601 74288
Albany courthouse cupola, 1903 <sup>1</sup> .	44 38 05.82 123 06 24.31	321 24 27 67 54 06	141 30 17 247 35 22	Peterson..... Mary.....	4.247040 4.581843	17682.0 38180.6	57946 126264
Forest Peak, tallest trees, 1903.	44 40 22.978 123 20 52.841	40 55 31.0 227 20 53.5	220 46 56.5 20 36 34.5	Mary..... Yam..... Hult.....	4.393952 4.666792 4.776126	24714.5 46215.9 59720.7	81064 151627 195934
Round Peak, 1903...	44 37 52.709 122 34 54.345	66 32 19.8 80 00 05.7 187 24 19.8 172 28 37.1	246 16 03.4 259 19 15.6 317 00 34.8 352 21 28.2	Peterson..... Mary..... Yam..... Barnes.....	4.526021 4.826888 4.814986 5.001722	39498.2 78313.7 65297.2 100397.3	108992 256934 214231 323987
Thomas, cairn, 1903.	44 38 10.938 122 34 19.315	66 11 53.3 79 42 15.8 136 34 51.0	245 55 12.3 259 01 01.0 316 10 41.7	Peterson..... Mary..... Yam.....	4.560650 4.895576 4.815683	34431.0 79172.8 65412.8	112962 250753 214608
Mount Jefferson, 1903.	44 40 29.156 121 47 55.280	53 50 37.1 79 17 59.6 82 53 24.4 112 33 05.6 141 59 59.6 166 43 29.4	232 56 16.5 268 28 43.7 261 39 34.1 291 36 11.6 321 19 33.6 346 31 14.3	Spencer..... Peterson..... Mary..... Yam..... Barnes..... Larch.....	5.109880 4.976073 5.147584 5.059309 5.081770 4.991509	128780.4 94639.6 140470.1 114632.8 120717.4 98083.9	422537 310497 460859 376001 386054 321731
Monmouth Peak, 1903.	44 47 51.810 123 32 31.994	226 50 08.6 254 01 14.1 1 18 42.3	47 07 03.9 74 36 21.4 181 18 18.6	Yam..... Hult..... Mary.....	4.634728 4.833036 4.512641	42124.9 64082.6 32556.7	141486 223368 106813
Salem Capitol,dome, 1903 <sup>1</sup> .	44 56 19.47 123 01 43.50	146 50 53 268 37 32	326 46 02 88 50 56	Yam..... Hult.....	4.215764 4.399507	16434.8 25095.6	53920 82334
Chemawa tank, 1903 <sup>1</sup>	45 00 11.41 123 59 36.91	119 19 23 284 11 15	299 13 08 101 23 10	Yam..... Hult.....	4.120850 4.354021	13485.0 22595.5	44242 74132
Table Rock, cairn, 1903.	44 58 14.226 122 18 33.078	62 41 39.8 88 41 38.0 99 07 35.3 150 54 46.0	241 49 11.6 268 24 31.6 278 32 12.5 330 35 59.0	Mary..... Hult..... Yam..... Barnes.....	5.040604 4.502685 4.822846 4.860287	111186.6 31840.9 66503.7 70841.4	364795 104465 218188 232419
Arquett, cairn, 1903.	45 04 19.542 122 15 32.310	71 29 32.7 88 25 06.6 142 51 42.3	251 10 17.5 218 48 33.9 322 30 45.8	Hult..... Yam..... Barnes.....	4.576875 4.842732 4.803044	37746.4 66319.7 63539.5	123840 228411 208463

<sup>1</sup> Checked by vertical angles only.

## Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Supplementary points—Continued.</i>							
White church spire, west of Brooks, 1903. <sup>1</sup>	45 07 25.83 122 56 30.05	314 34 45 66 46 58	134 44 28 246 38 20	Hult..... Yam.....	4.404325 4.286586	26370.3 17241.9	83236 56568
Fairdale Peak, 1903. <sup>1</sup>	45 15 09.97 123 14 10.05	307 47 30 240 50 31	128 09 44 166 54 19	Hult..... Yam.....	4.718211 4.349885	52265.0 32381.3	171473 73429
Sheridan Peak, highest green tree, 1903. <sup>1</sup>	45 16 53.64 123 26 49.37	301 12 17 315 24 22	121 43 31 135 37 19	Hult..... Yam.....	4.830674 4.538082	67744.5 34125.7	222258 111961
Squaw, cairn, 1903...	45 18 51.206 122 02 24.710	78 12 49.8 120 51 29.4	257 26 55.7 300 21 10.6	Yam..... Barnes..... Larch.....	4.948008 4.810210 4.526919	88717.2 64566.7 32890.2	291036 211931 110693
Eagle cairn, 1903 <sup>1</sup> ...	45 16 25.88 122 04 54.19	118 29 55.3 179 11 18.5	298 01 22.8 359 11 05.1	Barnes..... Larch.....	4.773937 4.460062	59406.9 28444.4	194904 94634
Mount Hood, peak, 1903.	45 22 27.122 121 41 48.666	73 33 10.7 102 00 29.2	252 31 35.7 281 15 27.4	Yam..... Barnes..... Balch..... Larch.....	5.074616 4.924867 4.906772 4.547322	118745.2 84113.8 51668.5 35203.2	389583 275963 265928 115693
Fir, 1903.....	45 31 23.055 122 44 46.238	295 11 61.5 8 09 28.8	115 11 39.9 188 09 28.5	Cem..... Hill.....	3.111504 3.198313	1268.0 1343.7	4242 4408
Monument, General Land Survey, 1903.	45 31 11.938 122 44 34.806	23 58 29.5 144 09 14.0	208 58 15.0 359 09 06.8	Hill..... Fir.....	3.038393 2.626968	1079.9 426.6	3543 1990
Hill, 1903.....	45 30 39.970 122 44 55.028	176 26 18.0 240 10 43.2	356 26 14.4 60 11 27.9	Barnes..... Cem.....	3.242892 3.195468	1749.4 1568.4	5739 5146
Cem, 1903.....	45 31 05.230 122 48 52.358	123 20 05.0 198 44 48.5	303 19 16.7 18 48 38.8	Barnes..... River.....	3.245183 3.822185	1758.5 6646.8	5779 21786
River, 1903.....	45 34 28.864 122 42 13.910	285 42 28.7 34 07 13.5	105 48 25.4 214 05 14.9	Rocky Butte..... Barnes.....	4.0514797 3.8079902	11258.5 6462.7	30937 21085
Oregonian, 1903.....	45 31 13.209 122 40 38.967	161 11 63.4 231 11 25.6	341 09 55.6 71 16 14.4	River..... Rocky Butte.....	3.8050089 3.9672517	6682.8 9273.7	20941 30425
Portland longitude station, 1887.	45 31 08.82 122 40 39.75	.....	.....	.....	2.13537	136.6	448
Portland latitude station, 1887.	45 31 08.83 122 40 39.84	187 56 52	7 56 53	Oregonian.....	2.10969	128.7	422
Portland bench mark (U.S.G.S.), 1903.	45 31 09.07 122 40 39.77	.....	.....	Oregonian.....	2.10969	128.7	422
Rocky Butte (Oreg.) 1889.	45 32 49.861 122 33 54.303	81 09 27.93 140 59 28.21	261 01 32.80 320 46 20.26	Barnes..... Warren..... Davis.....	4.1049670 4.5744937 4.6962679	14620.66 37539.95 49689.84	47967.9 123162.3 163024.1
Harney (Wash.), 1881.	45 37 21.744 122 37 53.588	328 15 53.08 40 59 24.33	148 13 43.96 220 54 19.74	Rocky Butte..... Barnes.....	3.9941643 4.1495337	9806.53 14110.22	32370.4 40293.3
Balch (Oreg.), 1881..	45 31 54.574 122 42 30.763	80 15 16.28 210 43 44.61	260 13 29.77 30 47 02.60	Barnes..... Harney..... Rocky Butte.....	3.5167584 4.0701684 4.0543981	3286.69 11753.53 11334.39	10783.1 38561.4 37186.2
Vancouver Barracks flag staff west, 1903. <sup>1</sup>	45 37 87.91 122 39 36.04	282 39 59.2 32 13 36.7	102 41 12.5 212 09 45.3	Harney..... Barnes.....	3.357195 4.120055	2276.1 13184.2	7468 43255
Warren schoolhouse cupola, 1903. <sup>2</sup>	45 48 47.53 122 51 13.32	345 42 09.3 69 43 50.8	165 47 36.3 249 43 11.1	Barnes..... Warren.....	4.516405 3.105229	32840.1 1274.2	107743 4180
Mitchell, 1903 <sup>1</sup> .....	46 01 53.00 122 11 31.94	37 55 27 65 03 29	217 31 27 244 34 18	Barnes..... Warren.....	4.850660 4.763619	70902.3 58025.5	232619 190372
Mount Adams, 1903..	46 12 12.133 121 29 24.899	32 05 53.1 59 09 53.4	211 40 11.3 231 17 41.3	Larch..... Balch..... Barnes..... Bel.....	4.943096 5.080990 5.091261 4.864850	87719.5 120500.8 123384.6 73257.2	287793 395343 404904 240345

<sup>1</sup> Checked by vertical angles only.<sup>2</sup> No check on this position.

## Geographic positions—Continued.

Station.	Latitude and longitude.	Azimuth.	Back azimuth.	To station.	Distance.		
					Log (meters).	Meters.	Feet.
<i>Supplementary points—Continued.</i>							
Mount St. Helens, 1908.	46 11 53.028 123 11 25.864	353 45 06.3 30 24 56.9 161 21 14.0 196 21 48.7	173 49 22.9 210 00 51.4 341 09 50.7 16 22 38.5	Larch..... Barnes..... Hal..... Bel.....	4.871174 4.986196 4.796451 4.832490	74331.7 98336.8 62582.2 67907.0	248370 283257 205322 223087
Min, 1906.....	46 18 55.031 122 07 49.822	36 54 48.26 195 35 51.98	216 54 40.53 15 44 10.73	Len..... Bel.....	2.5905528 4.7339885	390.7 54198.2	1249 177809
Deschutes Peak, 1905.	46 39 25.252 122 21 54.262	141 03 59.3 166 44 01.2 246 15 51.1	321 00 10.8 346 37 33.9 06 34 26.0	Hal..... Hurst..... Bel.....	4.026608 4.688278 4.550058	10607.4 48784.1 35498.1	34801 160052 116424
Mineral Peak, 1905 <sup>1</sup> ..	46 38 56.26 122 09 27.44	150 54 20 227 45 19	330 38 47 47 54 50	Hurst..... Bel.....	4.743674 4.351832	55420.9 22481.8	181827 73759
High Rock, 1905.....	46 41 05.848 121 54 01.858	97 08 52.2 133 47 15.3 164 54 38.5	276 44 46.4 313 20 27.1 344 52 50.9	Hal..... Hurst..... Bel.....	4.028450 4.806714 4.000194	42506.0 64374.5 11486.7	139455 211202 37086
Goat Mountain, 1905 <sup>1</sup>	46 46 23.95 121 53 47.26	83 54 44 111 01 08	268 30 26 290 59 15	Hal..... Bel.....	4.630098 3.548435	42726.6 3535.4	140179 11599
Mount Rainier, high peak, 1906.	46 51 09.215 121 45 25.562	75 59 36.2 114 28 27.3	255 29 12.0 288 50 19.5	Hal..... Hurst.....	4.738514 4.700232	54766.4 62984.3	179679 206641
Mount Rainier, bare summit, 1906.	46 51 11.106 121 45 47.001	75 48 48.0 114 30 34.9	258 18 39.5 298 57 42.7	Hal..... Hurst.....	4.735119 4.700232	54339.9 62546.5	178280 206205
Sharp peak, 1905.....	47 01 04.392 121 53 20.964	8 27 57.5 53 37 01.4 69 03 14.7	188 25 44.7 238 12 21.8 278 35 52.2	Bel..... Hal..... Hurst.....	4.418390 4.728080 4.680627	26205.4 53468.3 47932.2	85976 175414 157268
Tacoma City Hall, 1905.	47 15 28.463 122 26 20.264	177 53 26.9 187 00 33.5 267 03 27.6	357 53 20.8 7 00 52.6 77 05 53.5	Drom..... Gull..... Bos.....	3.072844 3.651667 3.631972	4708.1 4484.0 4285.2	15446 14711 14069
Tacoma courthouse, 1905.	47 15 12.780 122 26 43.527	122 44 24.8 191 51 19.7 314 12 45.2	302 42 41.3 11 51 55.9 134 14 03.3	Wash..... Gull..... Kin.....	3.546524 3.702843 3.494135	3519.8 5042.5 3119.9	11548 16544 10236
Smelter stack, 300 feet high, 1905.	47 17 51.813 122 30 23.274	196 41 00.6 247 07 19.4 331 07 48.6	16 41 40.6 67 10 45.5 151 08 46.6	Neill 2..... Dash..... Wash.....	3.590017 3.805582 3.535934	3972.1 6390.9 3435.1	13032 20967 11270
Brown Point Light-house, 1906.	47 18 23.031 122 26 36.330	38 04 48.2 128 05 49.9 109 04 31.7	218 02 59.4 308 03 43.0 349 04 03.4	Wash..... Neill 2..... Piner 2.....	3.702914 3.663308 3.630626	5045.6 4605.8 4271.9	16554 15111 14015
Dash, 1857.....	47 19 12.171 122 25 42.896	37 39 18.36 105 35 50.58	217 36 50.30 285 33 04.37	Wash..... Neill 2.....	3.8408923 3.6926708	6992.54 4928.00	22744.5 16167.9
Piner 2, 1905.....	47 20 38.852 122 27 14.898	324 10 34.26 15 44 13.69 64 19 31.98	144 11 41.91 196 42 53.22 244 17 53.39	Dash..... Wash..... Neill 2.....	3.5186600 3.9286282 3.4945984	3301.11 8484.54 3123.19	10830.4 27836.4 10246.7
Robinson 2, 1867.....	47 23.11.720 122 22 31.984	28 27 36.29 51 32 05.89	208 25 15.86 231 28 37.75	Dash..... Piner 2.....	3.9249652 3.879391	8413.26 7584.71	27602.6 24884.2

<sup>1</sup> No check on this position.

\* Checked by vertical angles only.

## ELEVATIONS.

The datum for all the elevations is mean sea level.

The stations are in three classes: First, those fixed directly by the spirit leveling, and of which the elevations are subject to a probable error varying from  $\pm 0.15$  to  $\pm 0.3$  meter; second, the stations in the main scheme fixed by reciprocal measures of vertical angles and which are subject to probable errors varying from  $\pm 0.2$  to  $\pm 1.1$  meters, and, third, the intersection stations, of which the elevations are fixed by measurements of vertical angles which are not reciprocal, the intersection stations not being occupied, and whose elevations are subject to probable errors which may be as great as  $\pm 3$  meters in some cases.

The accuracy with which each elevation in the main scheme is determined depends mainly upon the remoteness of that station from the nearest one of which the elevation is fixed by spirit leveling, as indicated in class 1 of the following table. Station Snow Mountain west is probably least accurately determined of all the stations in the main scheme.

Table of elevations.

## THIRTY-NINTH PARALLEL TO WILLAMETTE BASE.

Station.	Point to which elevation refers.	Elevation.		Station.	Point to which elevation refers.	Elevation.	
<i>Class 1.</i>		<i>Meters.</i>	<i>Feet.</i>	<i>Class 2—Contd.</i>		<i>Meters.</i>	<i>Feet.</i>
Redding astronomic station.	Station mark	202.16	663.3	Roman.....	Station mark	872.3	2982
Gazelle astronomic station.	.....do.....	848.28	2783.1	Spencer.....	.....do.....	626.2	2054
Central Point astronomic station.	.....do.....	369.92	1213.6	Mary.....	.....do.....	1246.8	4097
Roseburg latitude station.	.....do.....	165.24	542.1	Peterson.....	.....do.....	437.2	1434
Willamette north base.	.....do.....	101.36	332.5	Twin.....	.....do.....	389.8	1279
Willamette south base.	.....do.....	116.59	382.5	R'dge.....	.....do.....	361.0	1184
				Rauch.....	.....do.....	202.2	663
<i>Class 2.</i>				<i>Class 3.</i>			
Mount Helena.....	.....do.....	1822.1	4338	Lassen Peak.....	Top.....	3189.9	10466
Snow Mountain, west.	Top of pier.	2145.7	7040	Mount Linn.....	.....do.....	2463.8	8083
Snow Mountain, east.	Station mark	2150.6	7056	Mount St. John.....	.....do.....	2057.6	6751
Marysville Butte.....	.....do.....	638.0	2003	Bully Chooop.....	.....do.....	2126.8	6978
Kent.....	.....do.....	2082.9	6670	Crater Peak.....	.....do.....	2646.5	8683
Lyons.....	.....do.....	2031.4	6665	Saw Tooth.....	Summit.....	2717.4	9015
Bally.....	.....do.....	1892.4	6209	Thompson Peak.....	Top.....	2555.0	8883
Round.....	.....do.....	1043.4	3423	Russian Peak, north point.	Highest sum. mit.	2494.3	8183
Spur.....	.....do.....	2766.9	9078	Pilot Rock.....	Summit.....	1803.9	5918
Boliver.....	.....do.....	2451.5	8043	China Mountain.....	.....do.....	2806.2	8551
Mears.....	.....do.....	2174.1	7133	Ashland Peak.....	.....do.....	2206.7	7535
Sterling.....	.....do.....	2230.3	7347	Marble Mountain.....	.....do.....	2533.3	8311
Soda.....	.....do.....	1857.4	6004	Mount Eddy.....	.....do.....	2754.8	9038
Onion.....	.....do.....	1597.1	5240	Mount Shasta.....	Top of peak.	4316.3	14161
Rust.....	.....do.....	1891.2	6205	Goose Nest.....	Tree-top.....	2398.5	7860
White.....	.....do.....	1222.7	4011	Redding Court-house.	Tangent to roof.	198.2	650
Black.....	.....do.....	1874.1	6149	Little Shasta.....	Top of peak.	2532.9	8310
Scott.....	.....do.....	1294.6	4247	Black Butte.....	Top of cairn.	1933.8	6344
Burg.....	.....do.....	608.7	1997	Preston Peak.....	Top of peak.	2232.2	7323
Rose.....	.....do.....	453.3	1487	Greyback.....	.....do.....	2149.5	7052
Fairview.....	.....do.....	1806.3	5926	Siskiyou.....	.....do.....	2178.4	7147
Yellow.....	.....do.....	746.3	2448	Wagner.....	Highest sum. mit.	2211.4	7255

## THIRTY-NINTH PARALLEL TO WILLAMETTE BASE—Continued.

Station.	Point to which elevation refers.	Elevation.		Station.	Point to which elevation refers.	Elevation.	
<i>Class 3—Contd.</i>							
Aspen Peak.....	Top.....	Meters.	Feet.	Prairie Peak.....	Top of peak.....	Meters.	Feet.
Mount Scott.....	Top of peak.....	2502.0	8209	Alsea Peak.....	do.....	1047.6	3437
Liso Rock.....	Top.....	2717.7	8916	Canahal Peak.....	do.....	1100.8	3612
High Rock (Oreg.).....	do.....	2493.0	8150	Herman Peak.....	do.....	869.4	2852
Union Peak.....	do.....	1893.8	6213	Seavies (U. S. G. S.).....	do.....	634.7	2082
Old Bailey.....	do.....	2347.9	7703	Mount Jefferson.....	do.....	697.3	1992
Dedson (U. S. G. S.).....	Top of peak.....	2548.3	8361	Left Nipple.....	do.....	3207.2	10522
Diamond Peak.....	do.....	964.5	3230	Corvallis closed cupola.....	Bottom of cupola, top of roof.....	1243.4	4079
Quartz.....	do.....	2679.7	8792	Corvallis open cupola.....	do.....	96.3	316
Mount Washington.....	do.....	1856.4	5533	Albany courthouse.....	Base, large cupola.....	98.2	322
Mount Zion.....	Top of peak.....	1406.4	4614	Lebanon.....	Top of tall brick chimney.....	88.1	289
North Sister.....	do.....	3088.4	10057	Salem, Capitol.....	Top, large part of dome.....	135.3	444
Haynick.....	do.....	2375.2	7793			100.4	329
Middle Sister.....	do.....	3059.6	10038				
Nebo.....	do.....	1037.4	3404				
South Sister.....	do.....	3155.2	10352				
Ball Butte.....	do.....	2756.6	9044				
St. Mary Butte.....	do.....	2789.6	9152				

## WILLAMETTE BASE NET TO TACOMA BASE.

Class 1.				Class 3.			
Oregonian.....	Top of tower.....	69.22	227.1	Round Peak.....	Top of peak.....	1312.8	4307
<i>Class 2.</i>							
Yam.....	Station mark.....	354.4	1163	Thomas.....	do.....	1820.5	4332
Hult.....	do.....	383.3	1258	Forest Peak.....	do.....	671.9	2204
Barnes.....	do.....	383.5	1258	White church spire.....	Top of square part.....	72.0	236
Larch.....	do.....	1234.9	4052	Monmouth Peak.....	Top of peak.....	984.6	3230
Warren.....	do.....	38.9	128	Table Rock.....	do.....	1487.8	4881
Rocky Butte.....	do.....	185.3	608	Arquett, cairn.....	do.....	1417.4	4450
River.....	do.....	50.2	165	Squaw.....	do.....	1455.9	4777
Harney.....	do.....	38.7	127	Chemawa tank.....	Foot of tank, top of tower.....	77.0	253
Davis.....	do.....	900.3	2954	Sheridan Peak.....	Top of peak.....	941.1	3088
Star.....	do.....	1328.7	4359	Fairdale.....	do.....	780.5	2561
Red.....	do.....	1517.3	4978	Mount Hood, peak.....	do.....	3421.2	11224
Lam.....	do.....	1383.1	4538	Mount Adams.....	do.....	3757.0	12326
Len.....	do.....	1785.6	5858	Mount St. Helens.....	do.....	2955.6	9097
Toutle.....	do.....	1001.7	3286	Deschutes Peak.....	do.....	1318.8	4327
Huck.....	do.....	1160.9	3809	High Rock (Wash.).....	do.....	1733.5	5687
Hal.....	do.....	1107.5	3634	Sharp Peak.....	do.....	1769.4	5805
Bel.....	do.....	1609.1	5476	Mineral Peak.....	do.....	1446.5	4746
Rain.....	do.....	538.0	1765	Mount Rainier.....	Bare summit.....	4389.5	14401
Pen.....	do.....	282.1	926	Mount Rainier.....	Highest point.....	4410.7	14471
Cem.....	do.....	325.8	1069	Goat Mountain.....	Top of peak.....	1847.8	6062
Hill (Oreg.).....	do.....	296.8	974	Mitchell.....	do.....	1213.7	3982
Fir.....	do.....	245.9	1135	Eagle, cairn.....	do.....	1283.0	4209
Monument, General Land Survey.....	do.....	289.7	950				

## TACOMA BASE TO PUGET SOUND.

Class 1.				Class 2—Contd.			
Tacoma city hall.....	U. S. G. S. B. M.	33.52	110.0	Tacoma astronomic	Station mark	94.79	311.0
<i>Class 2.</i>							
Gull.....	Station mark.....	51.67	169.5	Tacoma north base.....	do.....	124.70	409.1
Dron.....	do.....	27.59	90.5	Burn.....	do.....	122.14	400.7
Bos.....	do.....	2.59	8.5	Tacoma south base.....	do.....	122.57	402.1
Kim.....	do.....	102.46	336.2	Hurst.....	do.....	129.20	423.9
Wash.....	do.....	115.86	380.1	<i>Class 3.</i>			
Smelt.....	do.....	96.14	315.4	Smelter stack.....	Top of stack.....	132.7	435
Neill 2.....	do.....	4.02	13.2	Brown Point Light-house.....	Top of light shaft.....	8.5	28
Dash.....	do.....	2.98	7.8	Tacoma courthouse.....	Top of cupola.....	153.1	502
Piner 2.....	do.....	12.24	40.2				

### DESCRIPTIONS OF STATIONS.

This list may be conveniently consulted by reference to the illustrations at the end of this publication or to the index. All azimuths given in the descriptions are reckoned continuously from true south around by west to  $360^{\circ}$ , south being  $0^{\circ}$ , west  $90^{\circ}$ , north  $180^{\circ}$ , and east  $270^{\circ}$ . Where magnetic azimuths are given they are indicated as such. The distance between the station and reference mark is measured horizontally unless otherwise stated in the description.

In general, except where the contrary is specifically stated, the surface and underground mark are not in contact, so that a disturbance of the surface mark will not necessarily affect the underground mark. The underground mark should be resorted to only in cases where there is evidence that the surface mark has been disturbed.

The name and dates given in each description immediately after the county refer to the chief of party by whom the station was established, the date of the establishment of the station, and the date when the station was last recovered.

Any person who finds that one of the stations herein described has been disturbed or that the description no longer fits the facts is requested to send such information to the Director, Coast and Geodetic Survey, Washington, D. C.

### MARKING OF STATIONS.

The old type of station mark referred to in the following notes and descriptions consists of a disk and shank made of brass and cast in one piece. The disk is about 85 mm. in diameter and has a polished center surrounded by the raised letters "U. S. C. & G. S." and a raised flange around the edge. The shank is 25 mm. in diameter and 75 mm. long, with a slit at the lower end into which a wedge is inserted so that when it is driven into a drill hole in the rock it will bulge at the bottom and so hold the mark securely in place.

### GENERAL NOTES IN REGARD TO STATION MARKS.

**Note 1.**—A three-eighths-inch copper bolt 3 inches long is cemented into a drill hole in the rock, and directly above the bolt in the same drill hole is cemented an old-type station mark, described in the preceding paragraph. A cross in the top of the copper bolt and another in the polished center of the disk mark the station.

**Note 2.**—This marking is similar to that described in note 1, except that the copper bolt and the disk are in separate boulders and the boulder containing the bolt is at some distance beneath the surface. The cross on the disk is directly above the one on the bolt. The dimensions of the boulders are given in the description of the station.

**Note 3.**—The station is marked by an old-type station mark, described above, cemented into a drill hole in the rock. No underground mark was used.

### REFERENCE MARK.

**Note 4.**—This mark is a drill or punch hole in the top of a three-eighths-inch copper bolt 3 inches long, which is leaded or cemented into a drill hole in a rock with the top of the bolt flush with the surface.

### PRINCIPAL POINTS.

**Mount Helena** (Napa County, Calif., W. Eimbeck, 1876; 1908).—On the summit of Mount Helena, about 12 miles to the northward of Calistoga. The

station was originally marked by a fine drill hole and cross in the top of a one-half-inch copper bolt 5 inches long, which was cemented in a drill hole in bedrock, and by a brick pier 3 bricks square and 43 inches high, built over the bolt. When visited in 1908 it was found that the pier had been dynamited. Other instrument piers are at the following distances and directions from the station: Collimator pier, 2 bricks square and 61 inches high, 2.27 meters northwest; transit pier, 2 by 3 bricks and 39 inches high, 17.04 meters southwest; latitude pier, 2 by 2½ bricks and 36 inches high, 17.74 meters southwest of the station, and 1.68 meters east of the transit pier; vertical angle pier, 2 bricks square and 44 inches high, 33.31 meters southwest of the station and 16.92 meters a little south of east of the latitude pier. A boundary mark between Lake and Napa Counties, a large drill hole in a basaltic rock, is 2.18 meters northwest of the station.

**Marysville Butte** (Sutter County, Calif., W. Eimbeck, 1876; 1904).—About 15 miles west of Marysville on the southeastern summit of the south butte of the Marysville Buttes, about 6 meters northeast of the highest part of the summit, and near the steep cliff on the north side. The station is marked by an old-type station mark, described on page 23, set in a drill hole in a small rock embedded in the concrete that fills a depression in the solid rock. Below the concrete and directly under the station mark is a three-eighths-inch copper bolt 3 inches long set in a drill hole in the solid rock. Three reference marks, each of which is a three-eighths-inch copper bolt 3 inches long set in a drill hole in the rock, are at the following distances and azimuths from the station: 2.470 meters, 246° 48'; 2.635 meters, 5° 06'; and 2.915 meters, 103° 07'.

**Snow Mountain west** (Glenn and Lake Counties, Calif., E. F. Dickens, 1892; 1904).—On the highest point of the southwest summit of Snow Mountain. The summit is about 300 meters long in a northwest and southeast direction and about 50 meters wide at the station and is covered with small broken stones. There are a few scrub pines just below the pitch of the ridge about 100 meters southeast of the station. The station is marked by a one-half-inch brass bolt 3 inches long in a drill hole in the solid outcropping rock, and by a concrete pier 12 inches square and 44 inches high having embedded in its top a brass bolt directly above the one in the solid rock.

**Snow Mountain east** (Glenn County, Calif., W. Eimbeck, 1876; 1904).—On the northernmost rock-croppings at the edge of the summit of the eastern peak of Snow Mountain, about 5 miles south of Mount St. John and near the corner of Lake, Colusa, and Glenn Counties. The station is marked by a half inch copper bolt cemented in a drill hole in a hollow at about the middle of the highest point of rocks, with the top of the bolt about a half inch above the surface and marked by a cross. The reference marks are all drill holes in rocks, the first being distant 5.16 meters in azimuth 59° 57', the second 3.33 meters in azimuth 165° 39', and the third 6.89 meters in azimuth 248° 38'.

**Kent** (Tehama County, Calif., O. B. French, 1904).—On a high ridge about 8 or 10 miles east by south from Mount Linn and about 18 miles by road in a northwesterly direction from Paskenta, on a peak locally known as Bald Rock, on a ledge on the east side of the summit and about 8 or 9 feet lower than its highest part. Four or five hundred feet to the westward of the station and about 50 or 60 feet lower is a large, prominent, rocky knob. The station is marked according to note 1. The reference marks are described in note 4. The first one is in a large rock distant 5.01 meters in azimuth 212° 40', the second in a flat ledge distant 70.19 meters in azimuth 285° 50', and the third on the largest part of the ledge distant 47.72 meters in azimuth 5° 17'.

**Lyons** (Tehama County, Calif., O. B. French, 1904).—About 5 miles east of Lyonsville post office on a ridge known locally as Bald Hill, about 300 yards from the summit of the ridge on the shoulder extending toward Lyonsville and in the middle of a large group of boulders. A lone fir tree stands about 50 meters south by east from the station. The station is marked according to note 1. Two reference marks described in note 4, are in large rocks and at the following distances and azimuths from the station: 29.69 meters, 126° 59'; and 20.22 meters, 332° 22'.

**Bally** (Shasta County, Calif., O. B. French, 1904; 1920).—On the northernmost of the two main peaks on the summit of Bally Mountain, a prominent and well-known mountain about 15 miles by road west of Redding. The station mark, described in note 1, is in the top of a rock on the north side of the most prominent group of rocks on the peak and 5 or 6 feet below the top of the

For notes in regard to marking of stations see p. 23.

group. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 4.29 meters,  $247^{\circ} 07'$ ; and 10.62 meters,  $154^{\circ} 49'$ .

**Round** (Shasta County, Calif., O. B. French, 1904; 1919).—On the highest part of what is known as Round Mountain just north of the post office of the same name. The station mark, described in note 1, is in a large boulder which projects about 6 inches out of the ground. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 28.72 meters,  $345^{\circ} 30'$ ; and 6.43 meters,  $57^{\circ} 13'$ . The south reference mark is in the most eastern rock of a prominent group of rocks near the south end of the summit.

**Spur** (Siskiyou County, Calif., O. B. French, 1904; 1919).—On the west slope of Mount Shasta at an elevation of about 9,100 feet, in a position best identified by approaching the summit from Igema, by the road leading through Kite Canyon. In ascending this route several prominent peaks are discerned ahead and from the right-hand one a narrow shoulder extends in a westerly direction, or toward Black Butte. The station is about 50 meters below an abrupt change of slope of the ridge of this shoulder, and about 1 mile from the peak mentioned above. The station mark, described in note 1, is in the top of a large rock flush with the ground. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 13.77 meters,  $165^{\circ} 53'$ ; and 8.10 meters,  $228^{\circ} 47'$ .

**Mears** (Shasta County, Calif., O. B. French, 1904; 1920).—About 4 or 5 miles west by south from Castella and about southwest from Castle Crags, on the southern summit of the highest rocky peaks in the region known locally as Gray Rocks. The station is about 20 feet below the highest part of the peak and near the bluff on the south and east sides, with a ledge 3 or 4 feet higher about 10 feet distant toward the southeast. The peak was approached from the south and the 30-foot bluff near the station surmounted by means of ladders. The station is marked according to note 1. Two reference marks, described in note 4, are located as follows: The first in a boulder near the trail to the station, and distant 7.92 meters in azimuth  $70^{\circ} 50'$ ; and the second, on a low boulder east of a high pointed rock, and distant 17.77 meters in azimuth  $143^{\circ} 03'$ .

**Boliver** (Siskiyou County, Calif., O. B. French, 1904; 1920).—On the north side of a large group of boulders about 60 yards northeast of the highest part of the summit of Mount Scott, known locally as Old Craggy or Boliver, which is the high peak about 5 miles in a southerly direction from Callahan. The station is marked according to note 1. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 6.57 meters,  $272^{\circ} 41'$ ; and 9.88 meters,  $107^{\circ} 47'$ .

**Soda** (Jackson County, Oreg., O. B. French, 1904).—On a peak known locally as Old Baldy, in the Siskiyou Range of mountains, about 20 miles by road and trail southeast of Ashland and 5 miles east by north from Pilot Rock, a prominent peak in the same range. The best approach is from Ashland via Soda Springs and Davis's ranch. The station mark, described in note 1, is in a large rock whose upper surface is flush with the ground. Two reference marks, described in note 4, are in boulders whose tops are but slightly above ground and at the following distances and azimuths from the station: 12.91 meters,  $299^{\circ} 53'$ ; and 23.95 meters,  $35^{\circ} 36'$ .

**Gazelle astronomic station** (Siskiyou County, Calif., O. B. French; 1904; 1908).—About 250 yards north by east from the Gazelle railroad station near the center of the top of a very prominent knoll and about 40 feet northeast of the largest boulder on the knoll. The station mark, described in note 1, is in a rock below the surface of the ground. Three reference marks, described in note 4, are at the following distances and azimuths from the station: 19.20 meters,  $290^{\circ} 12'$ ; and 6.40 meters,  $137^{\circ} 39'$ . There is a concrete longitude pier, 7.330 meters east and 0.186 meter north of the station. This pier was recovered in 1919.

**Sterling** (Jackson County, Oreg., O. B. French, 1904).—In the Siskiyou range of mountains, about 25 miles southwest of Ashland and 2 miles west of Mount Sterling, on the northernmost summit of a ridge just south of the Silver Fork basin and at the western end of the long east-and-west valley which is just north of Mount Sterling. The station is about 80 or 90 meters southeast of the highest point of the summit in the center of a group of small boulders. The station mark, described in note 1, is in the top of a large rock. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 34.85 meters,  $18^{\circ} 13'$ ; and 20.44 meters,  $136^{\circ} 03'$ .

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**Rust** (Jackson County, Oreg., O. B. French, 1904).—On the highest summit of the peaks known locally as the Black Buttes (Rustler on U. S. Geological Survey maps), about 20 miles north of Mount Pitt and 26 miles by road and trail from Big Butte post office via Parker's ranch. The station is marked according to note 1. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 11.995 meters,  $264^{\circ} 33'$ ; and 10.12 meters,  $337^{\circ} 53'$ .

**Onion** (Douglas County, Oreg., O. B. French, 1904).—On the highest part of the bare summit of Onion Springs Mountain, about 1 mile south of the Onion Springs, and best reached from Glendale via Galesville and Gilpatrick's ranch. The station mark, described in note 1, is in a rocky ledge. Two reference marks, described in note 4, are located as follows: One in a prominent ledge and 24.62 meters from the station in azimuth  $91^{\circ} 50'$ , and the other in an inconspicuous, low boulder at the western edge of the summit and distant 47.22 meters in azimuth  $182^{\circ} 47'$ .

**Black** (Douglas County, Oreg., O. B. French, 1904).—Near the northeast corner of the highest part of the summit of Black Rock, a high, prominent, rocky peak about 40 miles in a direct line east of Roseburg and north and northwest of some near-by higher wooded peaks. The station mark, described in note 1, is in the solid rock of the summit. Two reference marks, described in note 4, are also in solid rock and at the following distances and azimuths from the station: 13.78 meters,  $4^{\circ} 55'$ ; and 6.47 meters,  $297^{\circ} 45'$ .

**White** (Douglas County, Oreg., O. B. French, 1904).—On the highest part of the summit of White Rock, a prominent peak about 15 miles east of Roseburg. The station mark, described in note 1, is in a large boulder. A reference mark, described in note 4, is in a large boulder just east of a prominent ledge and is 34.44 meters from the station, in azimuth  $353^{\circ} 11'$ .

**Scott** (Douglas County, Oreg., O. B. French, 1904).—On the highest part of the summit of Mount Scott, about 20 miles northeast of Roseburg. The station mark, described in note 1, is in a large boulder. Two reference marks, described in note 4, are located as follows: One in a white rock at about the middle of a prominent ledge and 32.71 meters from the station in azimuth  $195^{\circ} 02'$ ; and the other in a rocky ledge near the edge of the brush and 18.17 meters distant in azimuth  $305^{\circ} 42'$ .

**Fairview** (Lane County, Oreg., O. B. French, 1904).—On the west side of the summit of Fairview Peak in the Bohemia Mountains, about 25 miles southeast of Cottagegrove and 6 miles by road from Mineral post office. The station mark, described in note 1, is in a boulder. Three reference marks, described in note 4, are in rock ledges and at the following distances and azimuths from the station: 6.69 meters,  $74^{\circ} 29'$ ; 2.92 meters,  $181^{\circ} 39'$ ; and about 175 feet,  $266^{\circ} 09'$ .

**Yellow** (Douglas County, Oreg., O. B. French, 1904).—On the highest summit of the timbered ridge about 10 miles west of Yoncalla. The station is marked according to note 2, the subsurface mark in a boulder 8 by 12 by 16 inches placed 18 inches beneath the surface, and the surface mark in a boulder 10 by 20 by 30 inches, the top of which is flush with the surface of the ground. A reference mark, described in note 4, is in a rock ledge and 22.62 meters from the station in azimuth  $334^{\circ} 37'$ . Two other reference marks, consisting of three-sixteenths inch copper wires 3 inches long set in boulders, are at the following distances and azimuths from the station: 21.04 meters,  $197^{\circ} 31'$ ; and 20.70 meters,  $107^{\circ} 02'$ .

**Spencer** (Lane County, Oreg., O. B. French, 1903).—This station is near a United States Geological Survey station. It is on the south end and highest point of the summit of Spencer Butte, about 4 miles south of Eugene. Two trees used by the Geological Survey are at the north end of the summit, which is in the form of a ridge. The station is marked according to note 1. Two reference marks, described in note 4, are in rocks near the station, one distant 5.338 meters in azimuth  $175^{\circ} 02'$ , and the other 4.570 meters in azimuth  $328^{\circ} 51'$ . The Geological Survey station is 7.970 meters from the station in azimuth  $176^{\circ} 12'$ .

**Roman** (Douglas County, Oreg., O. B. French, 1903; 1906).—On the most westerly of the two summits of the highest peak of the Coast Range, known as Roman Nose or Saddle Mountain, situated near the north line of Douglas County about 5 miles southwest of the junction of Wild Cat Creek with the Siuslaw River. It is on the highest point of the summit, about 6 feet from the southern edge of the bluff and 20 feet from the steep part of the slope east of the

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station. The peak is bare except for a few low shrubs, and has a steep bluff on the south side and a gentle grassy slope on the north side. The station is marked according to note 2, the subsurface mark in a boulder 12 by 12 by 24 inches, 18 inches below the surface, set with the axis east and west, and the surface mark in a boulder measuring about a foot on each side. Two reference marks, described in note 4, are located as follows: One in the nearest outcropping of the solid rock 14.760 meters from the station in azimuth  $148^{\circ} 06'$ , and the other in a projecting boulder 6.775 meters from the station in azimuth  $205^{\circ} 33'$ . Arrows pointing to the reference marks are cut in the rock near each mark. An old burned stump is about 5 feet from the station in azimuth  $232^{\circ}$ .

**Mary** (Benton County, Oreg., O. B. French, 1903; 1908).—On the highest point of the grassy summit of Mary Peak, about south-southwest from Corvallis. The station is marked according to note 2, the subsurface mark in a flat stone 4 inches thick and 19 inches in diameter, 22 inches below the surface, and the surface mark in a boulder 16 by 18 by 30 inches, the top of which is flush with the surface of the ground. Two reference marks, described in note 4, are in boulders, and at the following distances and azimuths from the station: 13.77 meters,  $326^{\circ} 22'$ ; and 29.36 meters,  $58^{\circ} 11'$ .

**Peterson** (Linn County, Oreg., O. B. French, 1903).—About 4 miles southwest of Lebanon on the highest part of the most westerly of the two summits known as Peterson Butte. The station is marked according to note 1. Two reference marks, described in note 4, are located as follows: One in the lower part of the northerly sloping face of the largest rock on the south side of the summit, and 4.645 meters from the station in azimuth  $7^{\circ} 30'$ ; and the other in the ledge just east of the largest rock on the north side of the summit, and 3.270 meters distant in azimuth  $185^{\circ} 00'$ .

**Twin** (Linn County, Oreg., O. B. French, 1905).—On the farm of Mr. Gentry near the southwest corner of sec. 24, T. 14, R. 3 W., about 6 or 7 miles from Rowland. It is on the highest summit of a partly wooded ridge, the south slope being bare and the north slope wooded, and about 8 or 10 meters southeast of the highest point of the summit. The station is marked according to note 2, the underground mark in a stone about 2 feet below the surface and the surface mark in a large stone about 6 inches below the surface. Three reference marks, described in note 4, are at the following distances and azimuths from the station: 6.66 meters,  $314^{\circ} 42'$ ; 6.39 meters,  $53^{\circ} 57'$ ; and 6.87 meters,  $155^{\circ} 44'$ . The last-mentioned reference mark is near the highest point of the summit.

**Ridge** (Lane County, Oreg., O. B. French, 1905).—On the highest part of a ridge on land owned by Mr. J. J. Winn, about  $1\frac{1}{2}$  miles north of his residence, and about 10 miles by road in a northwesterly direction from Junction City. The station is marked according to note 2, with the subsurface mark 1.5 feet below the surface. Three reference marks, described in note 4, are in inconspicuous boulders flush with the surface of the ground, and at the following distances and azimuths from the station: 4.86 meters,  $164^{\circ} 32'$ ; 30.69 meters,  $278^{\circ} 43'$ ; and 9.73 meters,  $356^{\circ} 15'$ . A triangular blaze in a large maple tree is 11.63 meters from the station in azimuth  $92^{\circ} 16'$ , and a similar blaze in a large fir tree is 8.45 meters distant in azimuth  $213^{\circ} 33'$ .

**Rauch** (Lane County, Oreg., O. B. French, 1903).—About 12 miles west by south from Eugene,  $2\frac{1}{4}$  miles southwest of Llewellyn post office and about one-half mile west of the road leading from Llewellyn to Crow post office, on land belonging to Mrs. Frances Rauch. It is about 150 meters east of the summit on the north side of a sloping ridge about 300 feet higher than the valley through which the road runs, the first prominent ridge encountered in going from Llewellyn to Crow and the only ridge in the vicinity from which *Willamette south base* can be seen. The station is about 200 feet west of a point where the ridge becomes steeper. The station was marked according to note 2, the underground mark in a small, flat stone 2 feet below the surface and the surface mark in a rock about 12 by 12 by 18 inches flush with the surface. Two reference marks, described in note 4, are located as follows: One in a rock 10 by 10 by 18 inches on the highest part of the ridge and 11.96 meters from the station in azimuth  $286^{\circ} 02'$ , and the other in a rock 8 by 8 by 14 inches distant 12.22 meters in azimuth  $51^{\circ} 46'$ .

**Willamette south base** (Lane County, Oreg., O. B. French, 1903; 1908).—About 5 miles from Eugene and 220 meters south of the Eugene-Elmira road on land belonging to William Nelson. It is about 100 meters north of a large

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gravel pit, 78 meters from the line fence between William Nelson and M. Nelson, and about in line with the west face of the barn belonging to William Nelson which is 86.79 meters north of the station. The station is marked with old-type station mark described on page 23, placed in the center of a 6-inch drain tile and both embedded in a pillar of concrete 2 feet long, 36 inches in diameter at the base, 18 inches in diameter at the top, and set in the ground so that the tops of the pillar and tile and station mark are all flush with the surface of the ground. Six inches below the foot of this pillar a cross in the top of a  $\frac{1}{4}$ -inch copper bolt, embedded in a block of concrete 10 by 24 by 24 inches, forms the subsurface mark. In 1906 a concrete pillar  $2\frac{1}{4}$  feet high, 18 inches square at the base and 12 inches square at the top, with the letters "U.S.C.S." on the south side, was set over the surface mark. The first reference mark is a  $\frac{1}{4}$ -inch copper bolt in a concrete block 12 by 12 by 18 inches, the top of which is flush with the ground, with a similar block and bolt directly beneath it as subsurface mark, distant 212.29 meters from the station in azimuth  $177^\circ 32' 02''$ . The second mark, similar to the first, is at the junction of the road fence and that dividing the farms of William Nelson and M. Nelson, and 225.16 meters from the station in azimuth  $200^\circ 19' 30''$ . The third reference mark, similar to the preceding two but with no subsurface mark, is in the line of the boundary fence 78.38 meters from the station in azimuth  $265^\circ 16' 42''$ . The fourth mark is a  $\frac{1}{4}$ -inch copper bolt leaded into a drill hole in a large stone in the southwest corner of the foundation of the main part of William Nelson's barn, and is 86.79 meters from the station in azimuth  $181^\circ 30' 16''$ .

**Willamette north base** (Lane County, Oreg., O. B. French, 1905; 1908).—One and one-half miles south and one-half mile west of Junction City in the east center of sec. 7, T. 16, R. 4 W., on land owned by Mr. William M. Pitney of Junction City. It is in the northeast corner of a field on the south side of the main east-and-west road, about 71 yards from the north-and-south fence to the east and 4 or 5 yards from the fence on the south side of the road, and almost opposite the main gate which leads into the barnyard corral of the farm across the road. The subsurface station mark is a three-eighths inch copper bolt 6 inches long, set in a block of concrete  $3\frac{1}{2}$  by 4 feet and 10 inches deep, placed 3 feet below the surface. The surface mark is an old-type station mark described on page 23, set in the top of a concrete pier  $3\frac{1}{2}$  feet square at the base,  $1\frac{1}{2}$  feet square at the top, and 2 feet 5 inches deep, the top of which is flush with the surface of the ground. Surrounding the station mark and embedded in the concrete is an 8-inch drain tile 1 foot long with its rim about flush with the top of the pier. Each of the three reference marks consists of two three-eighths inch copper bolts, 3 inches long, each set in the top of a concrete post 1 foot square, the subsurface post being 9 inches long and  $2\frac{1}{2}$  to 3 feet below the surface, and the surface mark about 2 feet long, with its top 4 inches below the surface. The first reference mark is 6 inches south of the fence on the south side of the road and about in the prolongation of the fence line on the west side of the corral mentioned above, and is 32.058 meters from the station in azimuth  $97^\circ 10'$ . The second mark is in the corral across the road, about 10 inches from the road fence and 6 or 8 feet east of the east end of the main road gate, and is 19.876 meters from the station in azimuth  $186^\circ 24'$ . The third mark is on the south side of the main road, 12 or 15 feet from the road fence, and 6 inches west of the north-and-south fence, at a distance from the station of 65.076 meters in azimuth  $271^\circ 26'$ .

**Seavies 2** (Lane County, Oreg., W. H. Burger, 1908).—In the same locality as *Seavies* (U. S. G. S.). (See p. 35.) It is on the south slope of the peak near the lower edge of the first timber from the top and almost in line with *Spencer* (see p. 26) and the tangent line to the west bank of the McKenzie River at the big curve in the flat below the station. The station is marked by a drill hole in the rock and by piles of rock around the tripod erected at the station.

**Pisgah** (Lane County, Oreg., W. H. Burger, 1908).—Located north and east from Goshen on a hill known as Mount Pisgah, about 200 feet southwest, or toward Spencer Butte, from the highest point of the hill. The station is on top of a rock about 4 by 6 feet in area, projecting 16 inches above the ground, the largest one of a cluster of rocks, and, with the exception of a large rock on the west slope about 175 feet to the north, the largest rock in the vicinity. Station is marked by a one-half inch drill hole  $1\frac{1}{4}$  inches deep, 6 inches from the west edge of the rock and 23 inches from its south point.

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**Eugene astronomic station** (Lane County, Oreg., O. B. French, 1904: 1908).—This station is identical with the United States Geological Survey station. It is on the east end of Skinners Butte, near Eugene, Oreg., just above the reservoir and north of the railroad station, on the site of the old observatory of Oregon State University. It was learned in 1908 that the land was to be converted into a park and that the station would be demolished, so two marble reference stones, projecting 2 inches above the surface and bearing on the top the letters "U. S." with a cross between, were set to preserve the station. The first, 5 by 5 by 18 inches, is 18,294 meters from the station in azimuth 119° 59', and the second, 4 by 7 by 14 inches in size, is on the south brow of the hill 12,211 meters from the station in azimuth 52° 47'. A large concrete "O" on the brow of the hill overlooking the railroad station is in azimuth 2° from the station. The distance between the two reference marks is 17,825 meters, and from the first reference mark the Patterson School spire is in azimuth 315° 28', and the spire of the Humphrey Memorial Methodist Church is in azimuth 353° 53'.

**Yam** (Polk County, Oreg., O. B. French, 1903; 1908).—On the highest point of the highest of a group of hills about 12 miles northwest of Salem, and about 10 meters south of a wire fence which passes over the summit. A slightly lower wooded hill is about a half mile northwest of the station and a group of hills is about halfway between the station and Salem. The station is marked according to note 2, the surface mark in a boulder 15 by 18 by 18 inches with its top flush with the surface of the ground, and the subsurface mark in a boulder 8 by 16 by 16 inches and 23 inches below the surface mark. Two reference marks, described in note 4, are in boulders about 14 by 18 by 18 inches with their tops flush with the surface of the ground, and with a few loose stones piled about them for identification. One is in the line of the wire fence, 11.06 meters from the station in azimuth 197° 10', and the other 8.59 meters from the station in azimuth 329° 07'.

**Hult** (Marion County, Oreg., O. B. French, 1903).—On a prominent bare hill about 6 miles by road and 4 miles in a straight line southeast of Silverton, just south of the road from Silverton to Hult post office and on the farm of Al Porter. It is on the northeast side of the hill and slightly lower than the summit, 17 feet from a line fence on the west, and 8 feet from another fence on the south. The surface and underground marks at this station are crosses cut in the tops of one-half inch copper bolts embedded in boulders, the underground mark being in a boulder about 12 by 14 by 14 inches, with its top 1.9 feet below the surface mark, which is in a boulder about 14 by 18 by 24 inches, with its axis north and south. Two reference marks, described in note 4, are located as follows: One in a boulder about 14 by 16 by 16 inches, set in the fence line 5.79 meters from the station in azimuth 108° 55', and the other in a boulder about 14 by 16 by 24 inches, set in the fence line 7.125 meters from the station

**Barnes** (Multnomah County, Oreg., O. B. French, 1903).—On a cleared hill in azimuth 304° 40'.

about 4 miles west of Portland, between the Barnes and Cornell roads, and just east of the highest hill in this range, which hill is still densely wooded. It is on the south edge of the hill about 100 feet southeast of a fir tree and some small maple trees and close to the north side of a large stump. The station is marked according to note 2, the surface mark in a stone 8 by 14 by 18 inches with its top flush with the surface of the ground, and the subsurface mark in a stone 6 by 12 by 18 inches 14 feet below the surface mark. Two reference marks, described in note 4, and set at the roots of stumps on the sides facing the station are located as follows: One in a boulder 15 inches in diameter, distant 15.80 meters from the station in azimuth 156° 11'; and the other in a boulder 12 inches in diameter 7.02 meters from the station in azimuth 233° 23'. A third reference mark consists of a cross in the top of a boulder 10 inches in diameter buried 15 inches beneath the surface and of a copper bolt directly above the cross in a boulder 14 by 14 by 18 inches set with its top flush with the surface of the ground. It is about 3 feet north of the main east-and-west fence line, about 30 feet east of where this fence crosses the highest part of the ridge, about 3 feet east of a fence extending northward from this fence and 44.95 meters from the station in azimuth 184° 35'.

**Larch** (Multnomah County, Oreg., O. B. French, 1903; 1916).—Southeast of Bridal Veil, a town on the Columbia River, on the highest peak of Larch Mountain and on the west point of a small rock ledge which is on the north end of a spur from the main summit. The ledge is about 20 feet higher than

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the spur of which it forms the end, and descends abruptly on the north in a cliff about 100 feet high. It can be reached either from Bridal Veil or Latourell via Donahue's logging camp. The station is marked according to note 1. Two reference marks, described in note 4, are in the east summit of the ledge, one in rather a low place 10.89 meters from the station in azimuth  $298^{\circ} 51'$ , and the other near the east end of the summit 15.01 meters from the station in azimuth  $287^{\circ} 02'$ .

**Star** (Clark County, Wash., J. S. Hill, 1906; 1916).—On the most southerly of the two summits of Silver Star Mountain, on the line between Clark and Skamania Counties, about 35 miles northeast of Vancouver. The station was marked according to note 3. Two reference marks, described in note 4 are at the following distances and azimuths from the station: 5.910 meters,  $305^{\circ} 43'$ ; and 5.160 meters,  $26^{\circ} 11'$ .

**Davis** (Cowlitz County, Wash., J. S. Hill, 1906).—About 14 miles northeast of Woodland on the highest point of a hill on a north-and-south ridge which may be reached from Woodland by following the road up the Lewis River to the Fisher place and packing from there. The station is marked according to note 3. Two reference marks, described in note 4 are at the following distances and azimuths from the station: 5.81 meters,  $15^{\circ} 02'$ ; and 5.87 meters,  $96^{\circ} 51'$ .

**Red** (Skamania County, Wash., J. S. Hill, 1906).—On the highest point of a bald, red hill near the sources of the Little White Salmon and Lewis Rivers and not far from Klickitat Pass. It is best reached from White Salmon on the Columbia River via Guler post office, Ice Cave, Peterson's prairie, Goose Lake, Steamboat Lake, and the Indian race track, being about 1 mile southwest from the last place and  $1\frac{1}{2}$  miles west of Steamboat Lake. There is a Forest Service lookout station with its south wall about 2 meters north of the station mark. The station is marked according to note 3. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 7.400 meters,  $96^{\circ} 14'$ ; and 5.422 meters,  $188^{\circ} 46'$ .

**Warren** (Columbia County, Oreg., O. B. French, 1903).—About a mile southwest of Warren, a station on the Northern Pacific Railway, on a slight elevation or ridge near the west side of a pasture owned by Mr. E. Harness and about 250 meters north of an east-and-west road. The station is marked according to note 2, the surface mark in a bowlder 8 by 24 by 24 inches with the letters "U. S." cut in the north side and the subsurface mark in a stone 6 by 12 by 18 inches buried 18 inches below the ground. Three reference marks, described in note 4, are in the north-and-south fence line to the west of the station. The middle reference mark of the three is 246.7 meters north of the north road fence and the other two are each about 30 meters distant from the middle mark, one north and the other south. They are at the following distances and azimuths from the station: 23.67 meters,  $93^{\circ} 15'$ ; 37.46 meters,  $41^{\circ} 26'$ ; and 37.95 meters,  $142^{\circ} 46'$ .

**Lam** (Cowlitz County, Wash., J. S. Hill, 1906).—On the highest part of the heavily wooded summit of Elk Mountain, about 35 miles northeast of Woodland. The station is marked according to note 3. Two reference marks, described in note 4 are at the following distances and azimuths from the station: 6.28 meters,  $36^{\circ} 56'$ ; and 10.84 meters,  $319^{\circ} 02'$ .

**Len** (Skamania County, Wash., J. S. Hill, 1906).—In the northwestern part of Skamania County, about 10 miles north of Mount St. Helens and a short distance northeast of Spirit Lake. Spirit Lake can be reached by stage road from Castle Rock via Toutle and St. Helens, and from the south landing on this lake the peak on which the station is located appears as a rocky summit through a gap almost due north. The station is marked according to note 3. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 3.260 meters,  $215^{\circ} 15'$ ; and 12.220 meters,  $138^{\circ} 04'$ .

**Toutle** (Cowlitz County, Wash., O. B. French, 1906).—On the top of a conical hill, the highest point of a long ridge, known locally as Gum Mountain, between the north and south forks of the Toutle River and about 20 miles east of Castle Rock. The summit was heavily timbered in 1905 and lines of sight were cleared. The station is reached from Castle Rock via Toutle and St. Helens and the main road left at a point about  $2\frac{1}{2}$  miles east of St. Helens at Muniker's place, from where the station is about 3 miles distant in a southerly direction. The station is marked according to note 2, the underground mark in a stone 12 inches in diameter 2 feet below the ground and the surface

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mark in a boulder 12 by 18 by 24 inches. The reference marks are copper bolts set in the center of triangular blazes on each of three stumps on the sides facing the station, the first being 0.24 meters from the station in azimuth  $104^{\circ} 22'$ , the second 0.18 meters, in azimuth  $185^{\circ} 18'$ , and the third 0.90 meters, in azimuth  $345^{\circ} 34'$ . Two blazed trees are at the following distances and azimuths from the station: 18.24 meters,  $152^{\circ} 52'$ ; and 26.44 meters,  $257^{\circ} 50'$ .

**Huck** (Lewis County, Wash., O. B. French, 1905).—On a high, bald summit, known locally as Huckleberry Mountain, and about 8 miles northwest of the highest point of the Deschutes Mountains in this region. The station is on a level place on the summit and about 80 feet north of a sharp rocky point of about the same height. The station is marked by a one-half inch drill hole 1 inch deep in the top of a boulder 8 by 8 by 10 inches set flush with the surface of the ground. The reference marks, three in number, are similar drill holes in solid ledges along the west side of the ridge a little below its top, and at the following distances and azimuths from the station: 13.65 meters,  $40^{\circ}$ ; 7.30 meters,  $60^{\circ}$ ; and 5.60 meters,  $198^{\circ}$ .

**Bel** (Pierce County, Wash., O. B. French, 1905).—On a high rocky peak known as "Bel Jacket," about 10 or 12 miles a little south of west of Mount Rainier, and about  $9\frac{1}{2}$  miles by road from Ashford. From Ashford there is a wagon road leading to Messier's place about 5 miles distant, then a trail in the direction of Bald Rock and Eagle Rock, which leads to a small lake from where the peak may be seen about one-half mile distant a little to the west of north. The station is marked according to note 3. Three reference marks, described in note 4, are at the following distances and azimuths from the station: 7.26 meters,  $328^{\circ} 46'$ ; 5.24 meters,  $16^{\circ} 22'$ ; and 5.94 meters,  $188^{\circ} 29'$ . A drill hole is 16.89 meters from the station in azimuth  $15^{\circ} 01'$ .

**Hal** (Lewis County, Wash., O. B. French, 1905).—On the highest point of the most western one of the high, bald summits of the Deschutes Mountains near the northern line of Lewis County and due south of Tacoma. From the north the mountain appears as a symmetrical cone and is best approached from Yelm, a town on the Northern Pacific Railway, via Peter Stone's ranch, which is about 14 miles southeast of Yelm and a short distance north of the station. The station is near the south point of the hilltop and marked according to note 3. Three reference marks, described in note 4, are located as follows: The first in a large boulder, 10.55 meters from the station in azimuth  $166^{\circ} 24'$ , the second in a broad sloping ledge 4.81 meters distant in azimuth  $338^{\circ} 35'$ , and the third in about the highest point of rocks 2.71 meters distant in azimuth  $18^{\circ} 07'$ .

**Rain** (Thurston County, Wash., O. B. French, 1905).—About 10 meters northwest of the highest point of a prominent high hill about 4 miles south-southeast of the town of Rainier, about 1,200 feet above it, and just visible over the top of the timber from the town. It is probably in sec. 33, T. 16, R. 1 E., and it is about a mile west-northwest of the ranch on the top of the ridge owned by N. N. Bungard. The station is marked according to note 2, the subsurface mark in a boulder about 10 by 12 by 12 inches and 15 inches below the surface of the ground, and the surface mark in a boulder 12 by 20 by 20 inches. Two reference marks, described in note 4, are located as follows: One in a large boulder at the highest part of the hill, 8.75 meters from the station in azimuth  $8^{\circ} 54'$ , and the other in a boulder at some distance down the slope of the hill and 13.78 meters from the station in azimuth  $218^{\circ} 42'$ .

**Hurst** (Pierce County, Wash., O. B. French, 1905).—Near the north end and highest part of the timbered hill about 400 meters slightly south of west from the railroad station at Hillhurst, a town on the Northern Pacific Railway, and about one-half mile southwest of the store and post office. The hill is across the road south from the Cottage Grove Farm, owned by Mr. Bucholtz. The station is marked at the surface with an old-type station mark, described on page 23, set in a concrete block 12 inches square and 18 inches deep, and underground by a one-half inch copper bolt 4 inches long set in the solid ground or native cement 8 feet beneath the surface. There are two reference marks, one of which is a copper bolt set in the only large rock in the neighborhood, 40.34 meters from the station in azimuth  $252^{\circ} 40'$ , and the other is a similar copper bolt in a boulder 10 by 12 by 12 inches flush with the surface of the ground, with a smaller boulder 8 by 10 by 10 inches directly below it, and is 13.52 meters from the station in azimuth  $150^{\circ} 41'$ .

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**Pen** (Pierce County, Wash., O. B. French, 1905).—About one-half mile south of Graham, a station on the Tacoma Eastern Railroad, about one-half mile northwest of Mr. Hansen's house, and 75 or 100 meters to the westward of the highest part of a flat, partly cleared summit. The station is marked according to note 2. Three reference marks, described in note 4, are at the following distances and azimuths from the station: 18.93 meters,  $242^{\circ} 50'$ ; 17.80 meters,  $87^{\circ} 58'$ ; and 23.15 meters,  $160^{\circ} 53'$ .

**Tacoma south base** (Pierce County, Wash., O. B. French, 1905).—About 10 miles south of Tacoma and 2 miles south of Spanaway Lake, on land belonging to William Sekor, in the prolongation of Pacific Avenue of Tacoma. From the top of the hill in South Tacoma this street is nearly a straight line and Tacoma base line lies along it. The station is on the highest bench near the south side of Sekor's property and near the highest point of the bench, being about 10 feet west of a small but prominent knoll. It is 178.5 meters from the fence on the south side of the field and 154.8 meters from the fence on the west side. The station is marked underground by a cross in the head of a one-half inch copper bolt 8 inches long set in a block of concrete  $2\frac{1}{4}$  feet square and 6 inches thick 3 feet beneath the surface, and at the surface by an old-type station mark, described on page 23, set in the top of a concrete cube  $2\frac{1}{4}$  feet on an edge which has a 4-inch drain tile 2 feet long at the center with its top flush with the surface of the concrete. There are three reference marks, each consisting of a copper bolt set in a concrete block 18 inches square and 6 inches thick buried 3 feet below the surface, and of a similar bolt above it in a concrete block 18 inches square and 30 inches deep, its top 2 inches below the surface of the ground. They are at the following distances and azimuths from the station: 49.658 meters,  $263^{\circ} 50'$ ; 38.938 meters,  $347^{\circ} 25'$ ; and 61.153 meters,  $173^{\circ} 25'$ .

**Tacoma north base** (Pierce County, Wash., O. B. French, 1905).—On Fern Hill, 4 miles south of Tacoma and about one-fourth mile north of the crossing of Pacific Avenue and the Puyallup Electric Railway. It is on a prominent knoll just south of the house owned and occupied by H. A. Wilhelm, 8.5 meters south of his south line and 19 meters east of the east line of Pacific Avenue. The subsurface mark at the station is a cross in the head of a one-half inch copper bolt 3 inches long set in a block of concrete 30 by 30 inches and 6 inches thick, 3 feet beneath the surface. The surface mark is an old-type station mark, described on page 23, set in a concrete cube  $2\frac{1}{4}$  feet on an edge which has a 4-inch drain tile 2 feet long at the center with its top flush with the surface of the concrete. There are three reference marks, each consisting of a one-eighth inch copper wire embedded in an underground block of concrete 14 by 14 inches and 6 inches thick set 3 feet below the surface, and of a surface mark consisting of a similar wire in a block 14 by 14 by 30 inches set with the top flush with the surface of the ground. They are located as follows: The first, just north of Dr. Rynning's north fence and 4 feet east of the east line of Pacific Avenue, 92.325 meters from the station in azimuth  $10^{\circ} 19'$ ; the second, south of the back part of Wilhelm's house and just south of his south fence, 47.757 meters from the station in azimuth  $259^{\circ} 51'$ ; and the third just south of Wilhelm's south fence and 2 feet east of the east line of Pacific Avenue, 19.672 meters from the station in azimuth  $117^{\circ} 04'$ .

**Burn** (Pierce County, Wash., O. B. French, 1905; 1919).—On a prominent ridge 2 or 3 miles southwest of the central part of the city of Tacoma, in a section of the city called Oakland, west of that part of the valley which is traversed by the Northern Pacific Railway in an east-and-west direction and almost in line with the east-and-west portion of the track, about three-fourths of a mile from its western end. It is on a summit about one-half mile west of a prominent schoolhouse, about 300 meters southeast of a house, and about 30 meters north of a private road leading from the house to the schoolhouse, which road is a continuation of Proctor Street. The station can be reached by the American Lake south car to Proctor Street. The station is marked according to note 2, with the subsurface boulder about 2 feet below the surface. Three reference marks, described in note 4, are located as follows: The first near a trail along the ridge and 23.53 meters from the station, in azimuth  $180^{\circ} 44'$ ; the second on the north edge of the road 25.13 meters distant, in azimuth  $320^{\circ} 00'$ ; and the third near the beginning of a slope 25.47 meters distant, in azimuth  $85^{\circ} 34'$ .

**Kin** (Pierce County, Wash., O. B. French, 1905).—On the top of a prominent hill in the southeastern part of Tacoma, just south of McKinley Park, in the

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block between Thirty-second Street and Wright Avenue and K and L Streets and very nearly halfway between Thirty-second Street and Wright Avenue. It is directly in line with the gable ends of the N. P. B. A. Hospital, a large brick building a couple of hundred yards to the westward of the station. The station is marked according to note 2. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 24.55 meters,  $215^{\circ} 48'$ ; and 18.47 meters,  $294^{\circ} 50'$ . This station has probably been lost, due to local improvements.

**Wash** (Pierce County, Wash., O. B. French, 1905).—Lost.

**Bos** (Pierce County, Wash., O. B. French, 1905; 1919).—In the flat about 2 miles east of Tacoma and one-third of a mile south of the trestle leading from the city across the marsh to the mills on the east side of the valley. It is about 75 meters northeast of a small white house at the north end of the strip of fast land which extends farthest into the marsh and on a very slight elevation, clear of trees and buildings, on the edge of a slough. The station is marked according to note 2, the lower mark in a small bowlder 15 inches below the surface and the upper mark in a bowlder about 10 inches in diameter projecting 3 inches above the surface of the ground. There are no reference marks, but a broken-topped fir tree is about 60 meters from the station, in azimuth  $331^{\circ} 44'$ , and the west corner of the small white house is 77.72 meters distant, in azimuth  $13^{\circ} 54'$ .

**Gull** (Pierce County, Wash., J. J. Gilbert, 1891; 1921).—On Commencement Bay, north of Tacoma, and about 1 mile southeast from Brown Point Lighthouse, on the bold bluff about 125 feet high, which is conspicuous on approaching the point from Tacoma. The station is about 15 feet from the edge of the bluff and in range with the tower of the Lowell School in Tacoma and the left tangent of the tall, dark, cylindrical building with a dome roof, which belongs to the Tacoma Lumber Co.'s mill, and bears about southwest from the station. The station is marked by a standard bronze tablet set in concrete and stamped on the face "Gull 1921," and the underground mark is a bottle buried  $2\frac{1}{2}$  feet below the surface. There is a standard bronze reference mark set in a concrete post 7.847 meters from the station in azimuth  $255^{\circ} 08'$ .

**Dron** (Pierce County, Wash., O. B. French, 1905; 1921).—On Commencement Bay, about one-half mile southeast of Brown Point Lighthouse and about one-half mile west of station *Gull*. It is on the highest part of a bluff point about 60 feet above the water and 20 or 25 feet inland from the edge of the bluff, in a thicket of madrona trees, some of which were felled to clear the line to station *Neill*. The station is marked by a standard bronze station mark set in a mass of concrete and stamped on the face "Dron 1921," and the underground mark is a cross in the top of a copper bolt set in a bowlder. There is a standard bronze reference mark set in a rock 4.42 meters from the station in azimuth  $175^{\circ} 08'$ .

**Smelt** (Pierce County, Wash., O. B. French, 1905; 1921).—On a ridge in the extreme northwestern part of Tacoma just south of Point Defiance Park. To reach the station take the Point Defiance Park car to North Forty-ninth Street, walk about 5 blocks west and climb the hill at the end of the street, the station is on the projection of North Forty-ninth Street, not far from the west edge of the main ridge, considerably below the highest point, and at about the same elevation as the small knoll some 300 feet west of the station. The station is marked as described in note 2, except that the top of the mark has been torn away leaving only the shank in the concrete. The reference mark is a copper slug set in a stone in place 53.16 meters from the station in azimuth  $236^{\circ} 33'$ .

**Neill 2** (Pierce County, Wash., O. B. French, 1905).—Lost.

**Tacoma astronomic station** (Pierce County, Wash., J. F. Pratt, 1892; 1905).—A stone pier near the north end of Wrights Park, Tacoma. A brick pier 17 inches square and  $5\frac{1}{2}$  feet long, used for latitude observations in 1894, is 12 feet 3 inches due east of the station.

#### SUPPLEMENTARY POINTS.

**Corning tower** (Tehama County, Calif., O. B. French, 1904).—The tower at the south end of the Maywood Colonization Building, a wood and plaster structure, just across the street from the Maywood Hotel and southwest from the railroad station.

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**Corning astronomic station** (Tehama County, Calif., W. H. Burger, 1908).—On the vacant lot just west of the Maywood Colonization Building at Corning. (See Corning tower, above.) The station is not marked but the following distances and azimuths to different parts of the Maywood Colonization Building were measured. Tower, 23.40 meters,  $247^{\circ} 24' 2''$ ; northwest corner of the porchlike part of the building known as the Arcade, 31.40 meters,  $207^{\circ} 55' 2''$ ; and southwest corner of the same Arcade, 16.84 meters,  $242^{\circ} 17' 8''$ .

**Redding courthouse** (Shasta County, Calif., O. B. French, 1904; 1908).—The center of the top of the dome of the courthouse upon which stands the statue of justice. The statue is eccentric to the center of the dome by about  $1\frac{1}{2}$  feet. A triangle with a small hole at the center is cut in the floor of the dome directly below the center of the dome and may be used as the station.

**Redding astronomic station** (Shasta County, Calif., O. B. French, 1904; 1908).—On a prominent hill about three-fourths of a mile south by west from the railroad station at Redding. To reach the station follow the railroad track south to milepost 259, which is marked at present by a board nailed to a telegraph pole, where will be found a United States Geological Survey bench mark, a metal tube with a brass top, and from here the station is west about one-fourth of a mile. The station is on the brow of a hill somewhat toward the south edge and not quite at the highest point. A live oak about 6 inches in diameter is on the edge of the hill just north of the line to the Geological Survey bench mark and a leaning pine tree about a quarter of a mile distant is in line with the Redding courthouse. The station is marked according to note 1, in the top of a large boulder projecting 4 inches above the ground. Two reference marks, described in note 4, are at the following distances and azimuths from the station: 20.22 meters,  $115^{\circ} 49'$ ; and 9.99 meters,  $188^{\circ} 17'$ .

**Redding south base** (Shasta County, Calif., W. H. Burger, 1908).—About 15 feet east of the railroad track at Redding and opposite a large steel oil tank. The station is marked only by a nail in the top of a wooden stub and by the three instrument stubs.

**Redding north base** (Shasta County, Calif., W. H. Burger, 1908).—Near the northwest corner of the cemetery south of the railroad station at Redding and about 15 feet east of the track. The station is marked only by a nail in a wooden stub and by the three instrument stubs around it.

**Hill** (Shasta County, Calif., W. H. Burger, 1908).—On the east brow of a ridge just north of the ridge on which *Redding astronomic station* is located (see above), and almost on the line between that station and the courthouse at Redding. The station is marked only by a wooden stub and the three instrument stubs surrounding it.

**Central Point astronomic station** (Jackson County, Oreg., O. B. French, 1904; 1908).—About 2 miles north of Central Point, near the intersection of the Southern Pacific Railway and the county road and in the northwest corner of the field which is just east of the county road and south of the private road leading to the house occupied by George Mims. The station is about 30 meters from the railroad. (See *Central Point latitude station*, below). The underground mark at the station is a three-fourths inch drill hole in the top of a triangular granite rock, set in cement 15 inches below the surface of the ground. The surface mark is an old-type station mark, described on page 23, set in the top of a granite rock which projects 2 inches above the surface and which is embedded in a mass of concrete 30 inches square and 12 inches deep. The reference mark, a United States Geological Survey bench mark, is at the intersection of the railroad and the county road, just east of the rail on the east side of the road and 28.15 meters from the station in azimuth  $31^{\circ} 55'$ .

**Central Point latitude station** (Jackson County, Oreg., W. H. Burger, 1908).—Near *Central Point astronomic station* (see above) and marked only by a wooden pier. The following distances and azimuths were measured: Astronomic station, 4.77 meters,  $116^{\circ} 41'$ ; United States Geological Survey bench mark (reference mark of astronomic station), 28.82 meters,  $41^{\circ} 18'$ . The north and west fences of the field are, respectively, 6.18 meters and 15.55 meters from the station.

**Rose** (Douglas County, Oreg., O. B. French, 1904).—On the highest point of the highest bald summit of a ridge about  $1\frac{1}{2}$  miles north of Roseburg. The station is marked according to note 2, the underground mark in a mass of concrete 1 foot below the surface and the surface mark in a boulder 9 by 14 by 18 inches flush with the surface of the ground. Two reference marks, described in note

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4, are at the following distances and azimuths from the station: 16.71 meters,  $12^{\circ} 24'$ ; and 7.49 meters,  $125^{\circ} 28'$ .

**Burg** (Douglas County, Oreg., O. B. French, 1904).—On a high, bald summit about 3 miles southeast of Roseburg. As seen from the iron bridge over the river just west of the railroad station, it is the highest and most distant peak visible up a small valley. The station is marked according to note 2, the underground mark in a mass of concrete 18 inches below the surface, and the surface mark in a bowlder 10 by 12 by 14 inches set flush with the surface of the ground. The reference mark, described in note 4, is in a bowlder just over the edge of the hill, 10.24 meters from the station in azimuth  $112^{\circ} 45'$ .

**Roseburg latitude station** (Douglas County, Oreg., O. B. French, 1904).—On the point of a spur across the river from the town of Roseburg, about 100 feet west from the end of the bridge and 60 feet above it. The station is marked according to note 1, set in a ledge of rock. Two reference marks, described in note 4, are located as follows: One in a prominent ledge 18.18 meters from the station in azimuth  $30^{\circ} 17'$ , and the other in the side of a ledge flush with the ground, 32.80 meters from the station in azimuth  $109^{\circ} 05'$ .

**Springfield Methodist Church** (Lane County, Oreg., W. H. Burger, 1908).—The lower and less prominent of the two churches at Springfield.

**Springfield Christian Church** (Lane County, Oreg., W. H. Burger, 1908).—The taller and more prominent of the two churches at Springfield.

**Deady Hall, west tower** (Lane County, Oreg., W. H. Burger, 1908).—Deady Hall is one of the two larger buildings of the University of Oregon at Eugene and has large square towers at both the east and west ends.

**Geary School spire**, Eugene (Lane County, Oreg., W. H. Burger, 1908).—The Geary School is the public school located at West Fourth and Madison Streets, Eugene.

**United Brethren Church spire**, Eugene (Lane County, Oreg., W. H. Burger, 1908).—At East Eleventh and Ferry Streets, Eugene.

**Patterson School spire**, Eugene (Lane County, Oreg., W. H. Burger, 1908).—The public school located one block west of the southwest corner of the campus of the University of Oregon, at Eugene.

**Baptist Church spire**, Eugene (Lane County, Oreg., W. H. Burger, 1908).—At East Eighth and Pearl Streets, Eugene.

**W. O. W. Hall spire**, Eugene (Lane County, Oreg., W. H. Burger, 1908).—The old Episcopal Church located at West Eighth and Lincoln Streets, Eugene, which is now being used as a hall by the Woodmen of the World.

**Courthouse flagpole** (Lane County, Oreg., W. H. Burger, 1908).—At East Eighth and Oak Streets, Eugene.

**Methodist Church spire** (Lane County, Oreg., W. H. Burger, 1908).—The Humphrey Memorial M. E. Church located at West Tenth and Willamette Streets, Eugene.

**Seavies (U. S. G. S.)** (Lane County, Oreg., O. B. French, 1904).—This station is identical with the United States Geological Survey station of the same name. It is on the most southern of the high hills, about 6 miles northeast of Eugene and about 30 or 40 feet southwest of and slightly lower than the highest part of the hill. The station is marked by a square stone 4 by 4 by 24 inches with its top a little below the surface. The old Geological Survey signal was still standing in 1904, anchored in place by rocks, and was not disturbed.

**Monument, General Land Survey** (Multnomah County, Oreg., O. B. French, 1903).—The initial intersection of the First Standard Parallel and the Willamette Meridian, a short distance southeast of Barnes. (See p. 29.) The station is in a fence corner and is marked by a stone post projecting 1½ feet above the ground.

**River** (Multnomah County, Oreg., O. B. French, 1903).—Near the junction of the two suburbs of Portland known as Arbor Lodge and Peninsula, on the east bank of the Willamette River about a mile east of Columbia University. It is on a slight elevation, the highest in the vicinity, and in the fence line on the north side of the boulevard along the river bank. It was placed as far east as possible and still keep the Oregonian Building in view. The station is marked by crosses cut in the tops of two bowlders, one placed near the surface of the ground and the other directly beneath at a depth of 1.7 feet, each stone bearing the letters "U. S. C. S." cut in the top.

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**Oregonian** (Multnomah County, Oreg., O. B. French, 1903).—The tall iron pole at the southeast corner of the tower of the Oregonian Building, at the northwest corner of Sixth and Adler Streets, Portland.

**Portland longitude station** (Multnomah County, Oreg., C. H. Sinclair, 1887; 1905).—This station has been destroyed.

**Portland latitude station** (Multnomah County, Oreg., C. H. Sinclair, 1887; 1905).—This station has been destroyed.

**Rocky Butte** (Multnomah County, Oreg., C. Rockwell, 1889; 1903).—On the north side of the highest part of the brush-covered summit of the butte, about 2 miles northeast of Montavilla. The station is marked by a hole drilled in a large round-topped bowlder.

**Harney** (Clarke County, Wash., C. Rockwell, 1881; 1903).—On the north bank of the Columbia River, about  $1\frac{1}{2}$  miles above the United States wharf at Vancouver, on the sloping bare bluff immediately above the road leading from Vancouver up the river. It is almost in front of the "Harney House," on land formerly owned by Gen. Harney, and about 80 meters east of the fence inclosing the race track. The underground mark consists of a glass bottle placed 3 feet below the surface, with the neck up, the center of the neck marking the station, and three other bottles placed on their sides at a depth of about 1 foot and at distances of about 6 feet from the center, with the necks of the bottles pointing toward the center. The surface mark is a small drill hole 2 inches deep in a basaltic bowlder, weighing about 350 pounds, placed with its top flush with the surface of the ground. The following bearings to the right of magnetic north were read at the station: East chimney of Harney House,  $27^{\circ} 05'$ ; triangle on tree,  $74^{\circ} 28'$ ; white house on south side of river,  $172^{\circ} 55'$ ; ventilator on barn,  $220^{\circ} 06'$ ; and corner of race track fence,  $276^{\circ} 47'$ .

**Balch** (Multnomah County, Oreg., C. Rockwell, 1881; 1906).—This station was occupied for azimuth in 1886. It is immediately northwest of the city limits of Portland, about a mile south of the Willamette River, on the first small level bench of the spur making out from the ridge west of the Cornell road, and about 25 feet above the road. The station is marked underground by a broken-necked bottle placed neck up 2 feet below the surface, and by a cross in the top of a copper bolt set in concrete 6 inches above the bottle, and at the surface by a cross on an old-type station mark described on page 23, set in concrete, which is inscribed with the letters "C. & G. S." The reference marks are the remains of two brick piers built in line to the west of the station, with their foundation about 20 inches below the surface, the nearest edge of the first pier being about 1 meter west of the station.

**Dash** (Pierce County, Wash., G. Davidson, 1857; 1905).—Lost.

**Piner 2** (King County, Wash., O. B. French, 1905; 1913).—On the southeast point of Maury Island, about 25 feet above high tide and 30 or 40 feet inland from high-water mark. A group of four piles is 30 or 40 meters east of the station, and a large rock, the largest in the vicinity, is in the water 50 or 60 meters south and a little west from the station. The station is marked by a three-fourths inch drill hole in a large stone set flush with the surface, and underground by a similar drill hole in a stone 2 feet below the surface of the ground. Two reference marks, each consisting of surface and subsurface stones, are at the following distances and azimuths from the station: 4.61 meters,  $86^{\circ} 55'$ ; and 4.65 meters,  $167^{\circ} 45'$ . This station could not be found in 1919 and the evidence seemed to be that it had slid over the bank.

**Robinson 2** (King County, Wash., J. S. Lawson, 1867; 1919).—On Robinson Point, on Maury Island, about 300 meters southwest of the scaffold light, on a bluff about 20 feet above high tide and 30 feet inland from high-water mark. The station is 95 meters southwest of the light keeper's dwelling, 42 meters southwest from the southeast corner of the light keeper's shed or barn, and about 2 meters west of the fence which extends southwest from the corner of the shed. A large madrona tree at the top of the bluff is 15 or 20 meters southwest of the station. The station is marked underground by a one-half inch drill hole in a stone buried 1 foot deep and at the surface by a similar hole in a stone, directly above the lower mark, set with its top flush with the surface of the ground. One reference mark is a one-half inch drill hole in a solid stone which is in line with the fence running southwest from the shed, and is 2.93 meters from the station in azimuth  $26^{\circ} 25'$ . The other reference mark consists of surface and subsurface stones, the lower one  $1\frac{1}{2}$  feet beneath the surface, and is 10.62 meters from the station in azimuth  $185^{\circ} 06'$ .

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## CONVERSION TABLES.

Lengths—Feet to meters (from 1 to 1000 units).

[Reduction factor: 1 foot = 0.3048006096 meter.]

Feet.	Meters.								
0	0.0	50	15.24008	100	30.48006	150	45.72009	200	60.96012
1	0.30480	1	15.54488	1	30.78486	1	46.02489	1	61.26498
2	0.60960	2	15.84968	2	31.08966	2	46.33909	2	61.56972
3	0.91440	3	16.15448	3	31.39446	3	46.64449	3	61.87452
4	1.21920	4	16.45928	4	31.69926	4	46.95920	4	62.17932
5	1.52400	5	16.76408	5	32.00408	5	47.24409	5	62.48412
6	1.82880	6	17.06888	6	32.30888	6	47.54869	6	62.78892
7	2.13360	7	17.37368	7	32.61367	7	47.85370	7	63.09373
8	2.43840	8	17.67848	8	32.91847	8	48.15850	8	63.39853
9	2.74321	9	17.98324	9	33.22327	9	48.46330	9	63.70333
10	3.04801	60	18.28804	110	33.52807	160	48.76810	210	64.06818
1	3.35281	1	18.59284	1	33.83287	1	49.07280	1	64.31248
2	3.65761	2	18.89764	2	34.13767	2	49.37770	2	64.61778
3	3.96241	3	19.20244	3	34.44247	3	49.68260	3	64.92258
4	4.26721	4	19.50724	4	34.74727	4	49.98780	4	65.22738
5	4.57201	5	19.81204	5	35.06207	5	50.29210	5	65.53218
6	4.87681	6	20.11684	6	35.36687	6	50.59690	6	65.83693
7	5.18161	7	20.42164	7	35.66167	7	50.90170	7	66.14173
8	5.48641	8	20.72644	8	35.96647	8	51.20630	8	66.44658
9	5.79121	9	21.03124	9	36.27127	9	51.51120	9	66.75138
20	6.09601	70	21.33604	120	36.57607	170	51.81610	220	67.06618
1	6.40081	1	21.64084	1	36.88087	1	52.12090	1	67.36093
2	6.70561	2	21.94564	2	37.18567	2	52.42570	2	67.66574
3	7.01041	3	22.25044	3	37.49047	3	52.73051	3	67.97054
4	7.31521	4	22.55525	4	37.79528	4	53.03531	4	68.27534
5	7.62002	5	22.86005	5	38.10008	5	53.34011	5	68.58014
6	7.92482	6	23.16485	6	38.40488	6	53.64491	6	68.88464
7	8.22962	7	23.46965	7	38.70968	7	53.94971	7	69.19374
8	8.53442	8	23.77445	8	39.01448	8	54.25451	8	69.49454
9	8.83922	9	24.07925	9	39.31928	9	54.55931	9	69.79934
30	9.14402	80	24.38405	130	39.62408	180	54.86411	230	70.10414
1	9.44882	1	24.68885	1	39.92888	1	55.16861	1	70.40894
2	9.75362	2	24.99365	2	40.23368	2	55.47371	2	70.71374
3	10.05842	3	25.29845	3	40.53848	3	55.77851	3	71.01864
4	10.36322	4	25.60325	4	40.84328	4	56.08331	4	71.32334
5	10.66802	5	26.90805	5	41.14808	5	56.38811	5	71.62814
6	10.97282	6	26.21285	6	41.45288	6	56.69291	6	71.93294
7	11.27762	7	26.51765	7	41.75768	7	56.99771	7	72.23774
8	11.58242	8	26.82245	8	42.06248	8	57.30251	8	72.54255
9	11.88722	9	27.12725	9	42.36728	9	57.60732	9	72.84735
40	12.19202	90	27.43205	140	42.67209	190	57.91212	240	73.15215
1	12.49682	1	27.73686	1	42.97689	1	58.21692	1	73.45698
2	12.80163	2	28.04166	2	43.28169	2	58.52172	2	73.76175
3	13.10643	3	28.34646	3	43.58649	3	58.82652	3	74.06655
4	13.41123	4	28.65126	4	43.89129	4	59.13132	4	74.37138
5	13.71603	5	28.95606	5	44.19609	5	59.43612	5	74.67615
6	14.02083	6	29.26086	6	44.50089	6	59.74092	6	74.98095
7	14.32563	7	29.56566	7	44.80569	7	60.04572	7	75.28575
8	14.63043	8	29.87046	8	45.11049	8	60.35052	8	75.59055
9	14.93523	9	30.17526	9	45.41529	9	60.65532	9	75.89535

## Lengths—Feet to meters (from 1 to 1000 units)—Continued.

Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.
250	76.20015	300	91.44018	350	106.06021	400	121.98024	450	137.16027
1	76.50493	1	91.74408	1	106.98001	1	122.22054	1	137.46507
2	76.80875	2	92.04978	2	107.26981	2	122.52985	2	137.76986
3	77.11455	3	92.35458	3	107.50462	3	122.83465	3	138.07468
4	77.41935	4	92.65039	4	107.80042	4	123.13045	4	138.37948
5	77.72415	5	92.96419	5	108.20422	5	123.44425	5	138.68428
6	78.02895	6	93.26399	6	108.50902	6	123.74905	6	138.98908
7	78.33375	7	93.57379	7	108.81382	7	124.05355	7	139.28388
8	78.63855	8	93.87859	8	109.11862	8	124.35835	8	139.58868
9	78.94335	9	94.13339	9	109.42324	9	124.66345	9	139.80348
260	79.24815	310	94.48819	360	108.72822	410	124.98825	460	140.20828
1	79.55295	1	94.79299	1	109.03802	1	125.27305	1	140.51308
2	79.85775	2	95.09779	2	110.38782	2	125.57785	2	140.81788
3	80.16255	3	95.40259	3	110.64262	3	125.88265	3	141.12268
4	80.46735	4	95.70739	4	110.94742	4	126.18745	4	141.42748
5	80.77215	5	96.01219	5	111.26222	5	126.49225	5	141.72228
6	81.07695	6	96.31699	6	111.55702	6	126.79705	6	142.03708
7	81.38175	7	96.62179	7	111.86182	7	127.10185	7	142.34188
8	81.68655	8	96.92659	8	112.16662	8	127.40665	8	142.64660
9	81.99135	9	97.23139	9	112.47142	9	127.71146	9	142.95149
270	82.29615	320	97.53620	370	112.77623	420	128.01626	470	143.26629
1	82.60097	1	97.84100	1	113.06103	1	128.32105	1	143.56109
2	82.90577	2	98.14580	2	113.38583	2	128.62585	2	143.86585
3	83.21057	3	98.45060	3	113.69063	3	128.93065	3	144.17069
4	83.51537	4	98.75540	4	113.99543	4	129.23546	4	144.47549
5	83.82017	5	99.06020	5	114.30023	5	129.54026	5	144.78029
6	84.12497	6	99.36500	6	114.60503	6	129.84505	6	145.08509
7	84.42977	7	99.66980	7	114.90983	7	130.14986	7	145.39089
8	84.73457	8	99.97460	8	115.21463	8	130.45465	8	145.69469
9	85.03937	9	100.27940	9	115.51943	9	130.75946	9	145.99849
280	85.34417	330	100.88420	380	116.92423	430	131.08426	480	146.30429
1	85.64897	1	100.88900	1	116.12903	1	131.39006	1	146.60909
2	85.95377	2	101.13280	2	116.43383	2	131.67386	2	146.91390
3	86.25857	3	101.43860	3	116.73863	3	131.97866	3	147.21869
4	86.56337	4	101.80340	4	117.04343	4	132.28346	4	147.52350
5	86.86817	5	102.10820	5	117.34823	5	132.58827	5	147.82830
6	87.17297	6	102.41300	6	117.65304	6	132.89307	6	148.12310
7	87.47777	7	102.71781	7	117.95784	7	133.19787	7	148.43790
8	87.78257	8	103.02261	8	118.26264	8	133.50267	8	148.74270
9	88.08738	9	103.32741	9	118.56744	9	133.80747	9	149.04750
290	88.39218	340	103.63221	390	118.87224	440	134.11222	490	149.35220
1	88.69698	1	103.93701	1	119.17704	1	134.41707	1	149.65710
2	89.00178	2	104.24181	2	119.48184	2	134.72187	2	149.96190
3	89.30658	3	104.54661	3	119.79664	3	135.02667	3	150.26670
4	89.61138	4	104.85141	4	120.00144	4	135.33147	4	150.57150
5	89.91618	5	105.15621	5	120.30624	5	135.63627	5	150.87620
6	90.22098	6	105.46101	6	120.70104	6	135.94107	6	151.18110
7	90.52578	7	105.76581	7	121.00584	7	136.24587	7	151.48590
8	90.83058	8	106.07061	8	121.31064	8	136.55067	8	151.79070
9	91.13538	9	106.37541	9	121.61544	9	136.85547	9	152.09550

## Lengths—Feet to meters (from 1 to 1000 units)—Continued.

Feet.	Meters.								
500	152.40030	550	167.64034	600	182.88037	650	198.12040	700	213.36043
1	152.70511	1	167.94514	1	183.18517	1	198.42520	1	213.66523
2	153.00991	2	168.24994	2	183.49967	2	198.73000	2	213.97003
3	153.31471	3	168.55474	3	183.79477	3	199.03480	3	214.27483
4	153.61951	4	168.85954	4	184.09957	4	199.33960	4	214.57933
5	153.92431	5	169.16434	5	184.40437	5	199.64440	5	214.88443
6	154.22911	6	169.46914	6	184.70917	6	199.94920	6	215.19423
7	154.53391	7	169.77394	7	185.01397	7	200.25400	7	215.49403
8	154.83871	8	170.07874	8	185.31877	8	200.55880	8	215.79883
9	155.14351	9	170.38354	9	185.62357	9	200.86360	9	216.10363
510	155.44831	560	170.68834	610	185.92837	660	201.16840	710	216.40843
1	155.75311	1	170.98314	1	186.23317	1	201.47320	1	216.71323
2	156.05791	2	171.28794	2	186.53797	2	201.77800	2	217.01803
3	156.36271	3	171.59274	3	186.84277	3	202.08280	3	217.32283
4	156.66751	4	171.89754	4	187.14757	4	202.38760	4	217.62764
5	156.97231	5	172.21234	5	187.45237	5	202.69241	5	217.93244
6	157.27711	6	172.51715	6	187.75718	6	202.99721	6	218.23724
7	157.58192	7	172.82195	7	188.06198	7	203.30201	7	218.54204
8	157.88672	8	173.12675	8	188.36678	8	203.60681	8	218.84684
9	158.19152	9	173.43155	9	188.67158	9	203.91161	9	219.15164
520	158.49632	570	173.73635	620	188.97638	670	204.21641	720	219.45644
1	158.80112	1	174.04115	1	189.28118	1	204.52121	1	219.76124
2	159.10592	2	174.34595	2	189.58598	2	204.82601	2	220.06604
3	159.41072	3	174.65075	3	189.89078	3	205.13081	3	220.37084
4	159.71552	4	174.95555	4	190.19558	4	205.43561	4	220.67564
5	160.02032	5	175.26035	5	190.50038	5	205.74041	5	220.98044
6	160.32512	6	175.56515	6	190.80518	6	206.04521	6	221.28524
7	160.62992	7	175.86995	7	191.10998	7	206.35001	7	221.59004
8	160.93472	8	176.17475	8	191.41478	8	206.65481	8	221.89484
9	161.23952	9	176.47955	9	191.71958	9	206.95961	9	222.19864
530	161.54432	580	176.78435	630	192.02438	680	207.26441	730	222.50445
1	161.84912	1	177.08915	1	192.32918	1	207.56922	1	222.80925
2	162.15392	2	177.39395	2	192.63399	2	207.87402	2	223.11405
3	162.45872	3	177.69876	3	192.93879	3	208.17882	3	223.41885
4	162.76352	4	178.00356	4	193.24350	4	208.48362	4	223.72365
5	163.06833	5	178.30836	5	193.54839	5	208.78842	5	224.02845
6	163.37313	6	178.61316	6	193.85319	6	209.09322	6	224.33325
7	163.67793	7	178.91796	7	194.15799	7	209.39802	7	224.63805
8	163.98273	8	179.22276	8	194.46279	8	209.70282	8	224.94285
9	164.28753	9	179.52756	9	194.76759	9	210.00762	9	225.24765
540	164.59233	590	179.83236	640	195.07239	690	210.31242	740	225.55245
1	164.89713	1	180.13716	1	195.37719	1	210.61722	1	225.85725
2	165.20193	2	180.44196	2	195.68199	2	210.92202	2	226.16205
3	165.50673	3	180.74676	3	195.98679	3	211.22682	3	226.46685
4	165.81153	4	181.05156	4	196.20159	4	211.53162	4	226.77165
5	166.11633	5	181.35636	5	196.50639	5	211.83642	5	227.07645
6	166.42113	6	181.66116	6	196.90119	6	212.14122	6	227.38125
7	166.72593	7	181.96596	7	197.20599	7	212.44602	7	227.68606
8	167.03073	8	182.27078	8	197.51080	8	212.75083	8	227.9936
9	167.33553	9	182.57557	9	197.81560	9	213.05663	9	228.29566

## Lengths—Feet to meters (from 1 to 1000 units)—Continued.

Feet.	Meters.								
750	228.60046	800	243.84049	850	250.08053	900	274.32055	950	299.56058
1	228.90526	1	244.14529	1	250.38532	1	274.62535	1	299.86538
2	229.21006	2	244.45006	2	250.69012	2	274.93015	2	300.17018
3	229.51486	3	244.75489	3	250.99492	3	275.24046	3	300.47496
4	229.81966	4	245.05969	4	250.20073	4	275.53975	4	300.77978
5	229.12446	5	245.36449	5	250.60452	5	275.84455	5	301.06453
6	230.42926	6	245.66926	6	250.90832	6	276.14925	6	301.35923
7	230.73406	7	245.97409	7	251.21412	7	276.45415	7	301.64418
8	231.03886	8	246.27889	8	251.51892	8	276.75895	8	301.93886
9	231.34366	9	246.58369	9	251.82372	9	277.06375	9	302.30378
760	231.64846	810	246.88849	860	262.12853	910	277.36855	960	292.06859
1	231.95326	1	247.19329	1	262.43332	1	277.67336	1	292.91339
2	232.25806	2	247.49809	2	262.73813	2	277.97816	2	293.21819
3	232.56287	3	247.80290	3	263.04263	3	278.28296	3	293.52290
4	232.86767	4	248.10770	4	263.34773	4	278.58776	4	293.82779
5	233.17247	5	248.41250	5	263.65253	5	278.89256	5	294.13259
6	233.47727	6	248.71730	6	263.95733	6	279.19736	6	294.43729
7	233.78207	7	249.02210	7	264.26213	7	279.50215	7	294.74219
8	234.08687	8	249.32690	8	264.56693	8	279.80696	8	295.04699
9	234.39167	9	249.63170	9	264.87173	9	280.11176	9	295.35179
770	234.69647	820	249.98650	870	265.17653	920	280.41656	970	295.65659
1	235.00127	1	250.24130	1	265.48133	1	280.72135	1	295.96139
2	235.30607	2	250.54610	2	265.78613	2	281.02616	2	296.26619
3	235.61087	3	250.85090	3	266.00063	3	281.33096	3	296.57090
4	235.91567	4	251.15570	4	266.30573	4	281.63576	4	296.87579
5	236.22047	5	251.46050	5	266.70053	5	281.94056	5	297.18059
6	236.52527	6	251.78530	6	267.00533	6	282.24536	6	297.48539
7	236.83007	7	252.07010	7	267.31013	7	282.55017	7	297.79020
8	237.13487	8	252.37490	8	267.61494	8	282.85497	8	298.09500
9	237.43967	9	252.67971	9	267.91974	9	283.15977	9	298.39980
780	237.74448	830	252.98451	880	268.22454	930	283.46457	980	298.70460
1	238.04928	1	253.29831	1	268.52034	1	283.70937	1	299.00940
2	238.35408	2	253.59411	2	268.83414	2	284.07417	2	299.31420
3	238.65888	3	253.89891	3	269.13894	3	284.37897	3	299.61900
4	238.96368	4	254.20371	4	269.44374	4	284.68377	4	299.92380
5	239.26848	5	254.50851	5	269.74854	5	284.98857	5	300.22860
6	239.57328	6	254.81331	6	270.05334	6	285.29337	6	300.53340
7	239.87808	7	255.11811	7	270.35814	7	285.59817	7	300.83820
8	240.18288	8	255.42291	8	270.66294	8	285.89297	8	301.14200
9	240.48768	9	255.72771	9	270.96774	9	286.20777	9	301.44780
790	240.79248	840	256.03251	890	271.27254	940	286.51267	990	301.75260
1	241.09728	1	256.33731	1	271.57734	1	286.81737	1	302.05740
2	241.40208	2	256.64211	2	271.88214	2	287.12217	2	302.36220
3	241.70688	3	256.94691	3	272.18694	3	287.42697	3	302.66701
4	242.01168	4	257.25171	4	272.49174	4	287.73178	4	302.97181
5	242.31648	5	257.55653	5	272.79655	5	288.09658	5	303.27661
6	242.62128	6	257.86132	6	273.10135	6	288.34138	6	303.58141
7	242.92608	7	258.16612	7	273.40615	7	288.64618	7	303.88621
8	243.23088	8	258.47092	8	273.71095	8	288.95098	8	304.19101
9	243.53568	9	258.77572	9	274.01575	9	289.25578	9	304.49561

## Lengths—Meters to feet (from 1 to 1000 units).

[Reduction factor: 1 meter = 3.280833333 feet.]

Meters.	Feet.								
0		50	164.04167	100	328.09333	150	492.12600	200	656.16667
1	3.28083	1	167.32260	1	331.36417	1	495.40583	1	659.44750
2	6.56167	2	170.30333	2	334.64500	2	498.68667	2	662.72833
3	9.84250	3	173.58417	3	337.92683	3	501.96760	3	666.00917
4	13.12333	4	177.16600	4	341.20867	4	505.24933	4	669.29000
5	16.40417	5	180.44583	5	344.48750	5	508.52917	5	672.57063
6	19.68500	6	183.72667	6	347.76833	6	511.81000	6	675.85167
7	22.96583	7	187.00750	7	351.04917	7	515.08833	7	679.13250
8	26.24667	8	190.28833	8	354.33000	8	518.37167	8	682.41333
9	29.52750	9	193.56917	9	357.61083	9	521.65250	9	685.69417
10	32.80833	10	196.85000	110	360.89167	160	524.93333	210	688.97500
1	36.08917	1	200.13063	1	364.17250	1	528.21417	1	692.25533
2	39.37000	2	203.41167	2	367.45333	2	531.49500	2	695.53667
3	42.65083	3	206.69250	3	370.78417	3	534.77583	3	698.81750
4	45.93167	4	209.97333	4	374.01500	4	538.05667	4	702.03633
5	49.21250	5	213.25417	5	377.20683	5	541.33750	5	705.37917
6	52.49333	6	216.58500	6	380.57667	6	544.61833	6	708.66000
7	55.77417	7	219.81583	7	383.85750	7	547.89917	7	711.94083
8	59.05500	8	223.09667	8	387.12833	8	551.18000	8	715.22167
9	62.33583	9	226.37750	9	390.41917	9	554.46083	9	718.50250
20	65.61667	70	229.65833	120	398.70000	170	557.74167	220	721.78333
1	68.89750	1	233.93917	1	396.98083	1	561.02250	1	725.00417
2	72.17833	2	236.22000	2	400.26167	2	564.30333	2	728.34500
3	75.45917	3	239.50083	3	403.54250	3	567.58417	3	731.62583
4	78.74000	4	242.78167	4	406.82333	4	570.86500	4	734.90667
5	82.02083	5	246.00260	5	410.10417	5	574.14583	5	738.18750
6	85.30167	6	249.28333	6	413.38500	6	577.42667	6	741.40833
7	88.58250	7	252.56417	7	416.66583	7	580.70750	7	744.74917
8	91.86333	8	255.84500	8	419.94667	8	583.98833	8	748.03000
9	95.14417	9	259.12583	9	423.22750	9	587.26917	9	751.31083
80	98.42600	80	262.46667	130	426.50833	180	590.55000	230	754.59167
1	101.70683	1	265.74750	1	429.79017	1	593.88083	1	757.87250
2	104.98667	2	268.02833	2	433.07000	2	597.11167	2	761.15333
3	108.26750	3	271.30917	3	436.35083	3	600.39250	3	764.43417
4	111.54833	4	274.59000	4	439.63167	4	603.67333	4	767.71500
5	114.82917	5	278.87083	5	442.91250	5	606.95417	5	770.99583
6	118.11000	6	282.15167	6	446.19333	6	610.23500	6	774.27667
7	121.39083	7	285.43250	7	449.47417	7	613.51583	7	777.55750
8	124.67167	8	288.71333	8	452.75500	8	616.79667	8	780.83833
9	127.95250	9	291.99417	9	456.03583	9	620.07750	9	784.11917
40	131.23333	90	295.27500	140	459.31667	190	628.35833	240	787.40000
1	134.51417	1	298.55583	1	462.59750	1	636.63917	1	790.68083
2	137.79500	2	301.83667	2	465.87833	2	629.92000	2	793.96167
3	141.07583	3	305.11750	3	469.15917	3	633.20083	3	797.24250
4	144.35667	4	308.39833	4	472.44000	4	636.48167	4	800.52333
5	147.63750	5	311.67917	5	475.72083	5	639.76250	5	803.80417
6	150.91833	6	314.96000	6	479.00167	6	643.04333	6	807.08500
7	154.19917	7	318.24083	7	482.28250	7	646.32417	7	810.36583
8	157.48000	8	321.52167	8	485.56333	8	649.60500	8	813.64667
9	160.76083	9	324.80250	9	488.84417	9	652.88583	9	816.92750

## Lengths—Meters to feet (from 1 to 1000 units)—Continued.

Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.
250	820.20683	300	984.25000	350	1,148.29167	400	1,312.33333	450	1,476.37500
1	823.48917	1	987.53083	1	1,151.57260	1	1,315.61417	1	1,479.65683
2	826.77000	2	990.81167	2	1,154.85333	2	1,318.89500	2	1,482.03667
3	830.05083	3	994.09250	3	1,158.13417	3	1,322.17583	3	1,486.21750
4	833.33167	4	997.37333	4	1,161.41500	4	1,326.45667	4	1,489.49833
5	836.61250	5	1,000.65417	5	1,164.69583	5	1,328.77917	5	1,492.77917
6	839.89333	6	1,003.95500	6	1,167.97667	6	1,332.01833	6	1,496.06000
7	843.17417	7	1,007.21583	7	1,171.25750	7	1,335.29917	7	1,499.34063
8	846.45500	8	1,010.49667	8	1,174.53833	8	1,338.58000	8	1,502.62167
9	849.73583	9	1,013.77750	9	1,177.81917	9	1,341.86083	9	1,505.90250
260	853.01667	310	1,017.05833	360	1,181.10000	410	1,345.14167	460	1,509.18333
1	856.29750	1	1,020.33917	1	1,184.38083	1	1,348.42250	1	1,512.44117
2	859.57833	2	1,023.62000	2	1,187.06167	2	1,351.70333	2	1,515.74500
3	862.85917	3	1,026.90083	3	1,190.94250	3	1,354.98417	3	1,519.02583
4	866.14000	4	1,030.18167	4	1,194.22333	4	1,358.26500	4	1,322.30667
5	869.42083	5	1,033.46250	8	1,197.50417	5	1,361.54583	5	1,525.58750
6	872.70167	6	1,036.74333	6	1,200.78500	6	1,364.82667	6	1,528.86833
7	875.98250	7	1,040.02417	7	1,204.06583	7	1,368.10750	7	1,532.14917
8	879.26333	8	1,043.30500	8	1,207.34667	8	1,371.38833	8	1,535.43000
9	882.54417	9	1,046.58583	9	1,210.62750	9	1,374.66917	9	1,538.71083
270	885.82500	320	1,049.86667	370	1,218.90633	420	1,377.95000	470	1,541.99167
1	889.10683	1	1,053.14750	1	1,217.18917	1	1,381.23083	1	1,545.27250
2	892.38667	2	1,056.42833	2	1,220.47000	2	1,384.51167	2	1,548.55333
3	895.66750	3	1,059.70917	3	1,223.75083	3	1,387.79250	3	1,551.83417
4	898.94833	4	1,062.99000	4	1,227.03167	4	1,391.07333	4	1,555.11500
5	902.22917	5	1,066.27083	5	1,230.31250	5	1,394.35417	5	1,558.39583
6	905.51000	6	1,069.55167	6	1,233.59333	6	1,397.63500	6	1,561.67667
7	908.79083	7	1,072.83250	7	1,236.87417	7	1,400.91583	7	1,564.95750
8	912.07167	8	1,076.11333	8	1,240.15500	8	1,404.19667	8	1,568.23833
9	915.35250	9	1,079.39417	9	1,243.43583	9	1,407.47750	9	1,571.51917
280	918.63333	330	1,082.67500	380	1,248.71667	430	1,410.75833	480	1,574.80000
1	921.91417	1	1,085.95583	1	1,249.99750	1	1,414.03917	1	1,578.08083
2	925.19500	2	1,089.23667	2	1,253.27833	2	1,417.32000	2	1,581.36167
3	928.47583	3	1,092.51750	3	1,256.55917	3	1,420.60083	3	1,584.64250
4	931.75667	4	1,095.79833	4	1,259.84000	4	1,423.88167	4	1,587.92333
5	935.03750	5	1,099.07917	5	1,263.12083	5	1,427.16250	5	1,591.20417
6	938.31833	6	1,102.36000	6	1,266.40167	6	1,430.44333	6	1,594.48500
7	941.59917	7	1,105.64083	7	1,269.68250	7	1,433.72417	7	1,597.76583
8	944.88000	8	1,108.92167	8	1,272.96333	8	1,437.00500	8	1,601.04667
9	948.16083	9	1,112.20250	9	1,276.24417	9	1,440.28583	9	1,604.32750
290	951.44167	340	1,115.48333	390	1,279.52500	440	1,443.56667	490	1,607.60633
1	954.72250	1	1,118.76417	1	1,282.80683	1	1,446.84750	1	1,610.88917
2	958.00333	2	1,122.04500	2	1,286.08667	2	1,450.12833	2	1,614.17000
3	961.28417	3	1,125.32583	3	1,289.36750	3	1,453.40917	3	1,617.45083
4	964.56500	4	1,128.60667	4	1,292.64833	4	1,456.69000	4	1,620.73167
5	967.84583	5	1,131.88750	5	1,296.92917	5	1,459.97083	5	1,624.01250
6	971.12667	6	1,135.16833	6	1,299.21000	6	1,463.25167	6	1,627.28333
7	974.40750	7	1,138.44917	7	1,302.49083	7	1,466.53250	7	1,630.57417
8	977.68833	8	1,141.73000	8	1,305.77167	8	1,469.81333	8	1,633.85500
9	980.96617	9	1,145.01083	9	1,308.05260	9	1,473.09417	9	1,637.13583

## Lengths—Meters to feet (from 1 to 1000 units)—Continued.

Meters.	Feet.								
500	1,640.41667	550	1,804.45833	600	1,968.50000	650	2,132.54167	700	2,296.58333
1	1,643.09750	1	1,807.73917	1	1,971.78083	1	2,135.92250	1	2,299.86417
2	1,646.79833	2	1,811.02000	2	1,975.06167	2	2,139.10333	2	2,303.14500
3	1,650.25617	3	1,814.30083	3	1,978.34267	3	2,142.38417	3	2,306.42583
4	1,653.54000	4	1,817.58167	4	1,981.62333	4	2,145.66500	4	2,309.70667
5	1,656.82083	5	1,820.86260	5	1,984.00417	5	2,148.04583	5	2,312.98750
6	1,660.10167	6	1,824.14333	6	1,988.18500	6	2,152.22667	6	2,316.26833
7	1,663.38250	7	1,827.42417	7	1,991.46583	7	2,156.50750	7	2,319.54917
8	1,666.66333	8	1,830.70500	8	1,994.74667	8	2,158.78533	8	2,322.88000
9	1,669.94417	9	1,833.98583	9	1,998.02750	9	2,162.06917	9	2,326.11083
510	1,673.22500	560	1,837.20667	610	2,001.30833	660	2,165.35000	710	2,329.39167
1	1,676.50583	1	1,840.54750	1	2,004.58917	1	2,168.63083	1	2,332.67250
2	1,679.78667	2	1,843.82833	2	2,007.37000	2	2,171.91167	2	2,335.95333
3	1,683.06750	3	1,847.10167	3	2,011.15083	3	2,175.19250	3	2,339.23417
4	1,686.34833	4	1,850.39000	4	2,014.13167	4	2,178.47333	4	2,343.51500
5	1,689.62817	5	1,853.67083	5	2,017.71250	5	2,181.75417	5	2,345.79583
6	1,692.91000	6	1,856.95167	6	2,020.99333	6	2,185.03400	6	2,349.07667
7	1,696.19083	7	1,860.23350	7	2,024.27417	7	2,188.31583	7	2,352.35750
8	1,699.47167	8	1,863.51333	8	2,027.55500	8	2,191.59667	8	2,355.63833
9	1,702.75250	9	1,866.79417	9	2,030.83583	9	2,194.87760	9	2,358.91917
520	1,706.03333	570	1,870.07500	620	2,034.11667	670	2,198.15833	720	2,362.20000
1	1,709.31417	1	1,873.35583	1	2,037.32750	1	2,201.43917	1	2,365.48083
2	1,712.59500	2	1,876.63667	2	2,040.67833	2	2,204.72000	2	2,368.71617
3	1,715.87583	3	1,879.91750	3	2,043.95917	3	2,208.00083	3	2,372.04250
4	1,719.15667	4	1,883.19833	4	2,047.24000	4	2,211.28167	4	2,376.32333
5	1,722.43750	5	1,886.47917	5	2,050.52083	5	2,214.56250	5	2,378.60433
6	1,725.71833	6	1,889.76000	6	2,053.80167	6	2,217.84333	6	2,381.88500
7	1,728.99917	7	1,893.04083	7	2,057.08250	7	2,221.12417	7	2,385.16583
8	1,732.28000	8	1,896.32167	8	2,060.36333	8	2,224.40500	8	2,388.44667
9	1,735.56083	9	1,899.60250	9	2,063.64417	9	2,227.68383	9	2,391.72750
530	1,738.84167	580	1,902.88333	630	2,064.92500	680	2,230.96667	730	2,395.00833
1	1,742.12250	1	1,906.16417	1	2,070.20583	1	2,234.24750	1	2,398.28917
2	1,745.40333	2	1,908.44500	3	2,073.49607	2	2,237.52833	2	2,401.57000
3	1,748.68417	3	1,912.72583	3	2,076.76750	3	2,240.80917	3	2,404.85083
4	1,751.96500	4	1,916.00687	4	2,080.04833	4	2,244.09000	4	2,408.13167
5	1,755.24583	5	1,919.28750	5	2,083.32917	5	2,247.37083	5	2,411.41250
6	1,758.52667	6	1,922.56833	6	2,086.61000	6	2,250.65167	6	2,414.69333
7	1,761.80750	7	1,925.84917	7	2,089.89083	7	2,253.93250	7	2,417.97417
8	1,765.08833	8	1,929.13000	8	2,093.17167	8	2,257.21283	8	2,421.25500
9	1,768.36917	9	1,932.41083	9	2,096.45250	9	2,260.59417	9	2,424.53583
540	1,771.65000	590	1,935.69167	640	2,099.73833	690	2,263.77500	740	2,427.81667
1	1,774.93083	1	1,938.97250	1	2,103.01417	1	2,267.05583	1	2,431.09750
2	1,778.21167	2	1,942.25333	2	2,106.29500	2	2,270.33667	2	2,434.37833
3	1,781.49250	3	1,945.53417	3	2,109.57583	3	2,273.61750	3	2,437.65917
4	1,784.77333	4	1,948.81500	4	2,112.85667	4	2,276.93833	4	2,440.94000
5	1,788.05417	5	1,952.09583	5	2,116.13750	5	2,280.17917	5	2,444.22063
6	1,791.33500	6	1,955.37667	6	2,119.41833	6	2,283.46000	6	2,447.50167
7	1,794.61583	7	1,958.65750	7	2,122.69917	7	2,286.74083	7	2,450.78250
8	1,797.89667	8	1,961.93833	8	2,125.98000	8	2,290.02167	8	2,454.06333
9	1,801.17750	9	1,965.21917	9	2,128.26083	9	2,293.30250	9	2,457.34417

## Lengths—Meters to feet (from 1 to 1000 units)—Continued.

Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.	Meters.	Feet.
750	2,460.62500	800	2,624.06667	850	2,788.70683	900	2,952.75000	950	3,116.79167
1	2,463.00683	1	2,627.94750	1	2,791.98917	1	2,956.02063	1	3,120.07260
2	2,467.18067	2	2,631.22633	2	2,795.27000	2	2,959.31167	2	3,123.35333
3	2,470.46750	3	2,634.50917	3	2,798.55083	3	2,962.82620	3	3,126.63417
4	2,473.74833	4	2,637.79000	4	2,801.83167	4	2,965.87333	4	3,129.91500
5	2,477.02017	5	2,641.07063	5	2,805.11260	5	2,969.15417	5	3,133.19583
6	2,480.31000	6	2,644.35167	6	2,808.39833	6	2,972.43500	6	3,136.47667
7	2,483.59083	7	2,647.63260	7	2,811.67417	7	2,975.71583	7	3,139.75750
8	2,486.87167	8	2,650.91333	8	2,814.95600	8	2,978.99667	8	3,143.03833
9	2,490.15260	9	2,654.19417	9	2,818.23583	9	2,982.27750	9	3,146.31917
760	2,493.43333	810	2,657.47800	860	2,821.51067	910	2,985.55833	960	3,149.60000
1	2,496.71417	1	2,660.75583	1	2,824.79750	1	2,988.83917	1	3,152.88063
2	2,499.99800	2	2,664.03867	2	2,828.07833	2	2,992.12000	2	3,156.16167
3	2,503.27883	3	2,667.31750	3	2,831.35917	3	2,995.40083	3	3,160.44260
4	2,506.55867	4	2,670.59833	4	2,834.64000	4	2,998.63167	4	3,162.72333
5	2,509.83780	5	2,673.87917	5	2,837.92063	5	3,001.90250	5	3,166.00417
6	2,513.11833	6	2,677.16000	6	2,841.20167	6	3,005.24333	6	3,169.28500
7	2,516.39017	7	2,680.44063	7	2,844.48260	7	3,008.52417	7	3,172.56683
8	2,519.68000	8	2,683.72167	8	2,847.76833	8	3,011.80600	8	3,175.84667
9	2,522.96083	9	2,687.00250	9	2,851.04417	9	3,015.06583	9	3,179.12750
770	2,526.24167	820	2,690.28833	870	2,854.32600	920	3,018.36667	970	3,182.40833
1	2,529.52250	1	2,693.56417	1	2,857.60583	1	3,021.64750	1	3,185.68917
2	2,532.80333	2	2,696.84600	2	2,860.88667	2	3,024.92833	2	3,188.97000
3	2,536.08417	3	2,700.12583	3	2,864.16750	3	3,028.20917	3	3,192.25063
4	2,539.36500	4	2,703.40667	4	2,867.44833	4	3,031.49000	4	3,195.53167
5	2,542.64583	5	2,706.08750	5	2,870.72917	5	3,034.77083	5	3,198.81250
6	2,545.92667	6	2,709.36833	6	2,874.01000	6	3,038.05167	6	3,202.00333
7	2,549.20750	7	2,713.294917	7	2,877.29083	7	3,041.33250	7	3,205.37417
8	2,552.48833	8	2,716.53000	8	2,880.57167	8	3,044.61333	8	3,208.65500
9	2,555.76917	9	2,719.31083	9	2,883.85260	9	3,047.90417	9	3,211.93583
780	2,559.05000	830	2,723.09167	880	2,887.13333	930	3,061.17500	980	3,215.21667
1	2,562.33083	1	2,726.37260	1	2,900.41417	1	3,064.45583	1	3,218.49750
2	2,565.61167	2	2,729.59333	2	2,903.69500	2	3,067.77367	2	3,221.77833
3	2,568.89250	3	2,732.83417	3	2,906.97583	3	3,061.01750	3	3,225.05617
4	2,572.17333	4	2,736.21500	4	2,909.26667	4	3,064.29633	4	3,228.34000
5	2,575.45417	5	2,739.49683	5	2,913.53750	5	3,067.57917	5	3,231.62063
6	2,578.73600	6	2,742.77667	6	2,906.81833	6	3,070.80000	6	3,234.90167
7	2,582.01583	7	2,746.05750	7	2,910.09917	7	3,074.14083	7	3,238.18250
8	2,585.29667	8	2,749.33833	8	2,913.38000	8	3,077.42167	8	3,241.46333
9	2,588.57750	9	2,752.61917	9	2,916.60083	9	3,080.70250	9	3,244.74417
790	2,591.85833	840	2,755.90000	890	2,919.94167	940	3,083.98333	990	3,248.02600
1	2,595.13917	1	2,759.19083	1	2,923.22260	1	2,087.26417	1	3,251.30683
2	2,598.42000	2	2,762.46167	2	2,926.50333	2	3,090.54500	2	3,254.58667
3	2,601.70083	3	2,765.74250	3	2,929.78417	3	3,093.82583	3	3,257.86760
4	2,604.98167	4	2,769.02333	4	2,933.06500	4	3,097.10667	4	3,261.14833
5	2,608.26250	5	2,772.30417	5	2,936.34583	5	3,100.38750	5	3,264.42917
6	2,611.54333	6	2,775.58500	6	2,939.62667	6	3,103.60833	6	3,267.71000
7	2,614.82417	7	2,778.86583	7	2,942.90750	7	3,106.94917	7	3,270.90083
8	2,618.10600	8	2,782.14667	8	2,946.18833	8	3,110.23000	8	3,274.27167
9	2,621.38683	9	2,785.42750	9	2,949.46917	9	3,113.51083	9	3,277.55260

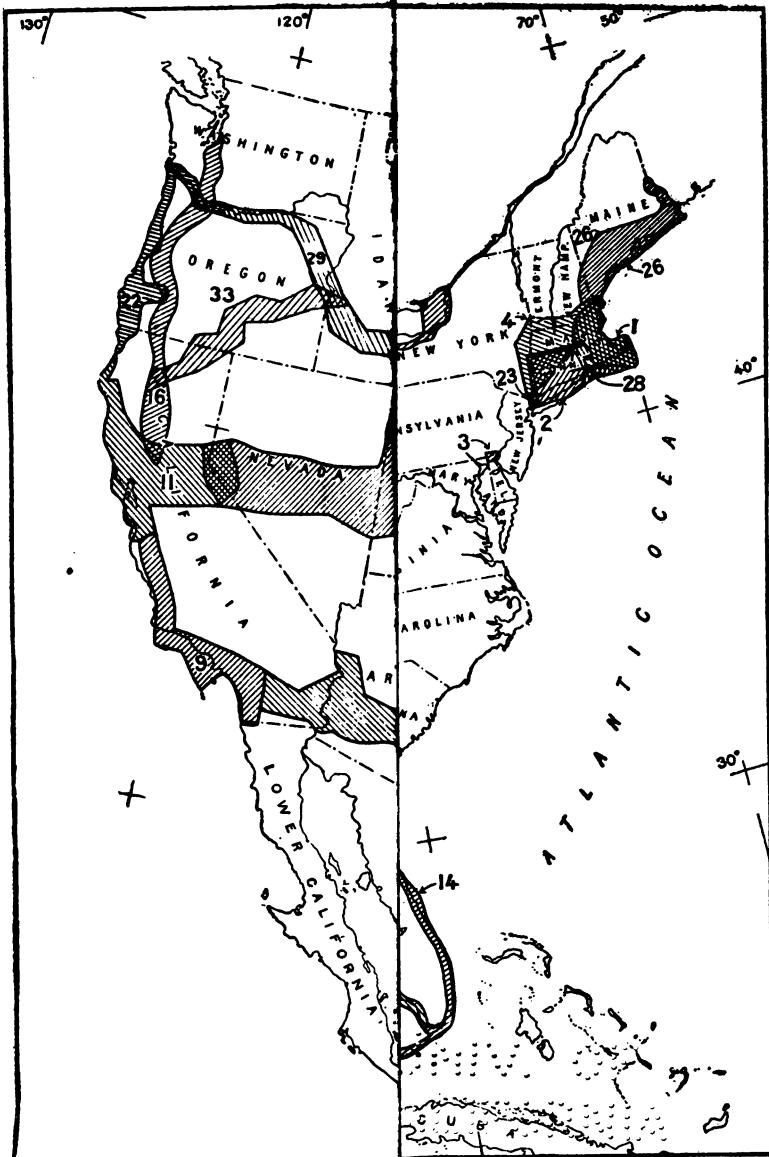


FIG. 1. 'INDEX MAP SHOWING WHICH HAVE BEEN RIGIDLY

1. Appendix 8, Report for 1885 (super-  
seded by Special Publication No.  
76).
2. Appendix 8, Report for 1888.
3. Appendix 8, Report for 1893.
4. Appendix 10, Report for 1894 (super-  
seded by Special Publication No.  
76).
5. Appendix 6, Report for 1901.
6. Appendix 10, Report for 1894 (super-  
seded by Special Publication No.  
76).
7. Appendix 8, Report for 1885 (super-  
seded by Special Publication No.  
76).
8. Appendix 8, Report for 1888.
9. Appendix 8, Report for 1893.
10. Appendix 10, Report for 1894 (super-  
seded by Special Publication No.  
76).
11. Appendix 6, Report for 1901.
12. Appendix 10, Report for 1894 (super-  
seded by Special Publication No.  
76).
13. Appendix 8, Report for 1885 (super-  
seded by Special Publication No.  
76).
14. Appendix 8, Report for 1888.
15. Appendix 8, Report for 1893.
16. Appendix 10, Report for 1894 (super-  
seded by Special Publication No.  
76).
17. Appendix 6, Report for 1901.
18. Appendix 10, Report for 1894 (super-  
seded by Special Publication No.  
76).
19. Appendix 8, Report for 1885 (super-  
seded by Special Publication No.  
76).
20. Appendix 8, Report for 1888.
21. Appendix 8, Report for 1893.
22. Appendix 10, Report for 1894 (super-  
seded by Special Publication No.  
76).
23. Appendix 6, Report for 1901.
24. Appendix 10, Report for 1894 (super-  
seded by Special Publication No.  
76).
25. Appendix 8, Report for 1885 (super-  
seded by Special Publication No.  
76).
26. Appendix 8, Report for 1888.
27. Appendix 8, Report for 1893.
28. Appendix 10, Report for 1894 (super-  
seded by Special Publication No.  
76).
29. Appendix 6, Report for 1901.
30. Appendix 10, Report for 1894 (super-  
seded by Special Publication No.  
76).
31. Appendix 8, Report for 1885 (super-  
seded by Special Publication No.  
76).
32. Appendix 8, Report for 1888.
33. Appendix 8, Report for 1893.

97454°—22. Face p. 44.



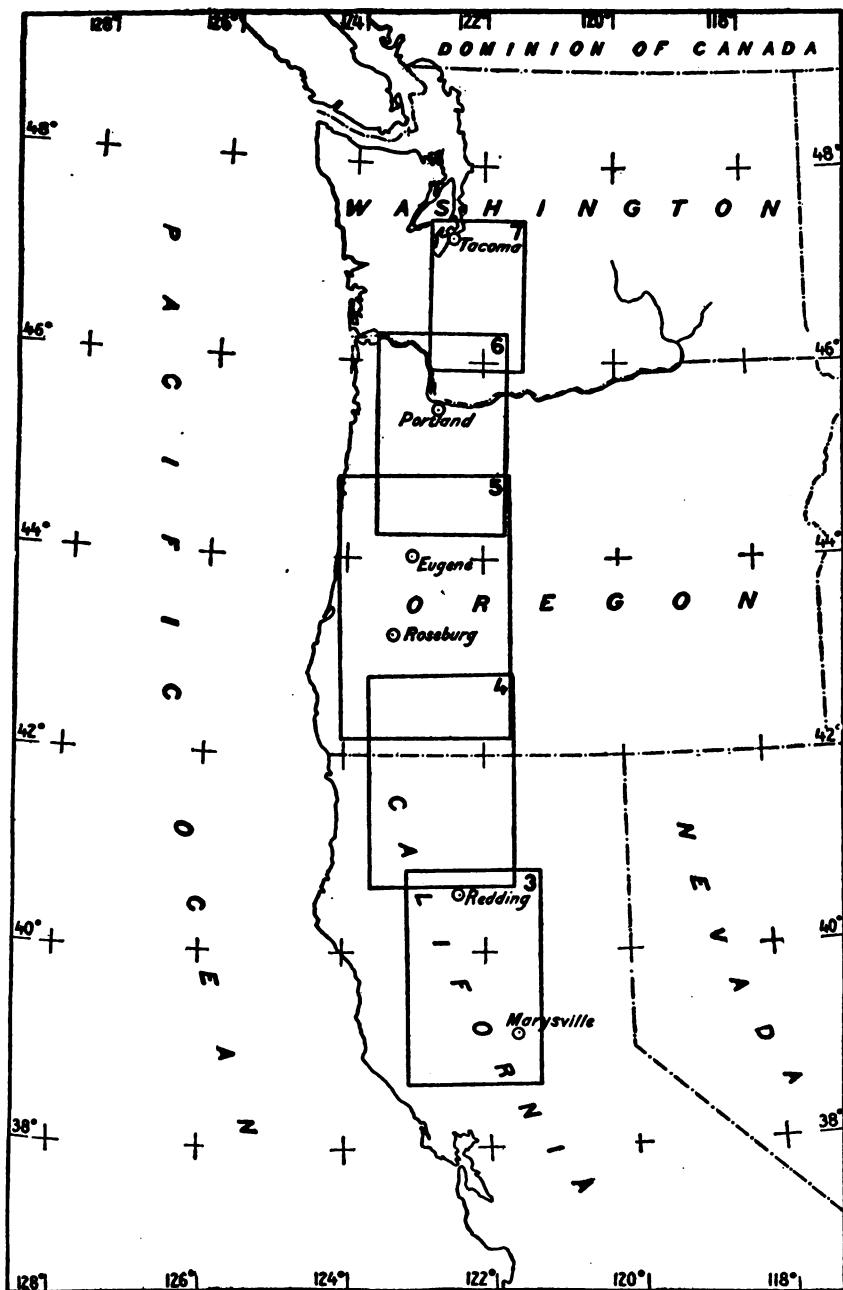


Fig. 2.—INDEX MAP OF THE CALIFORNIA-WASHINGTON ARC.

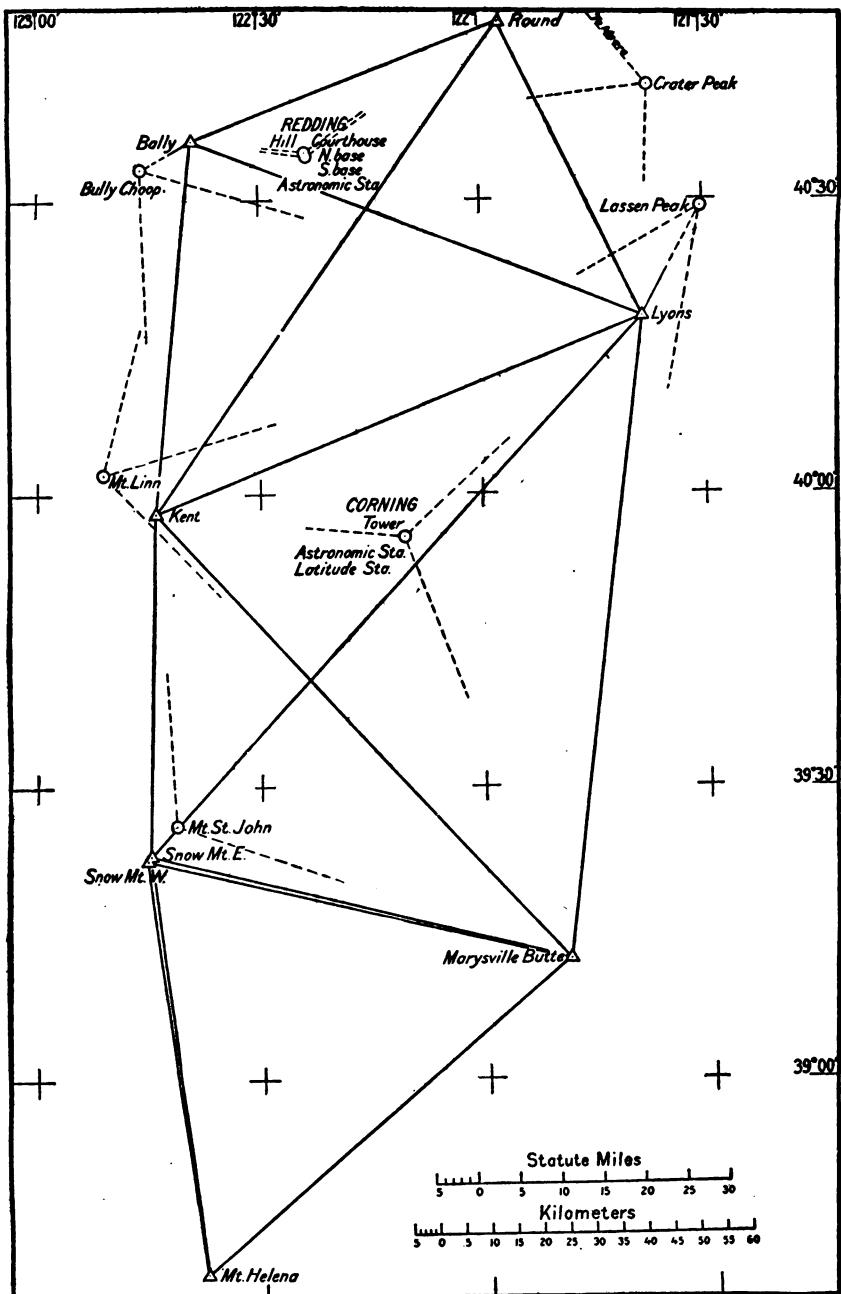


Fig. 3.—TRIANGULATION, THIRTY-NINTH PARALLEL TO VICINITY OF REDDING, CALIF.

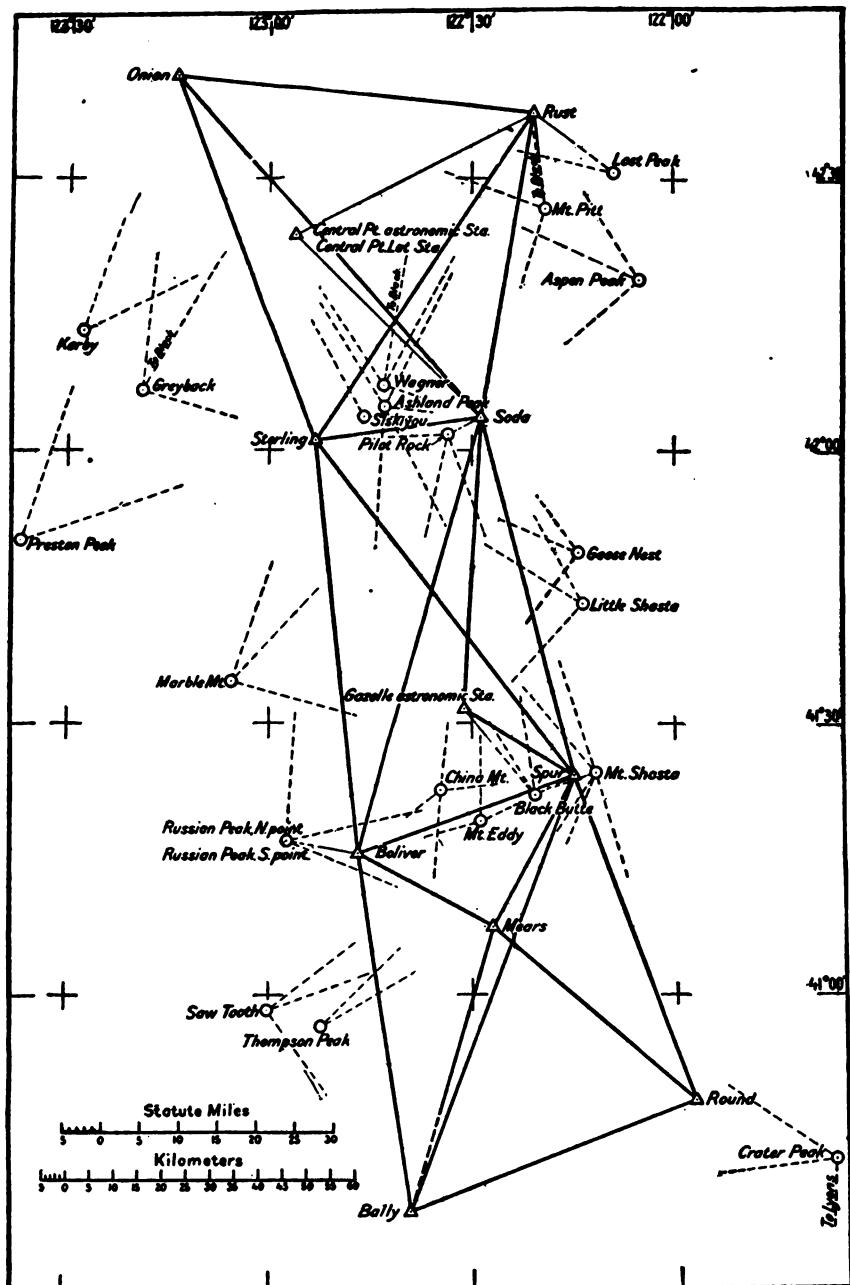


Fig. 4.—TRIANGULATION, VICINITY OF REDDING, CALIF., TO SOUTHERN OREGON,

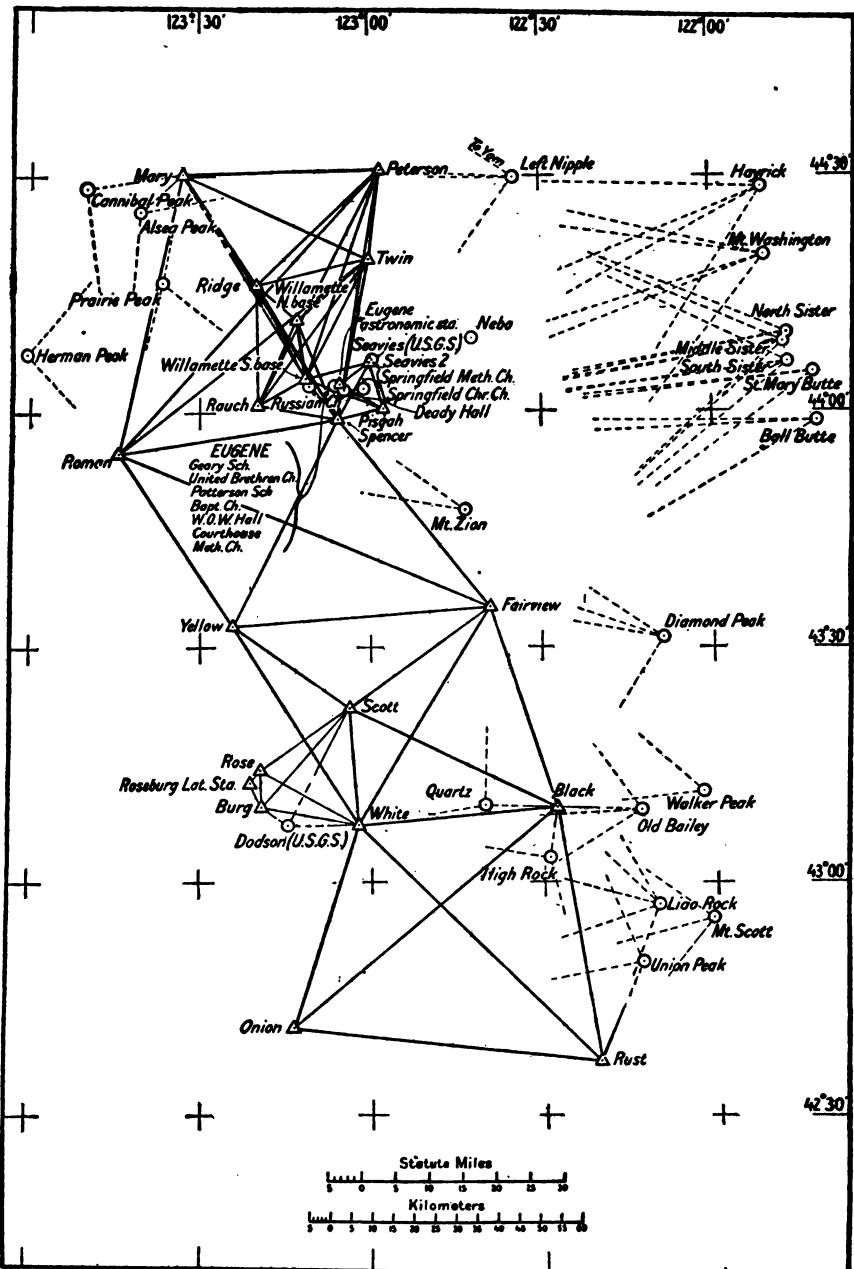


Fig. 5.—TRIANGULATION, SOUTHERN OREGON TO VICINITY OF EUGENE, OREG.

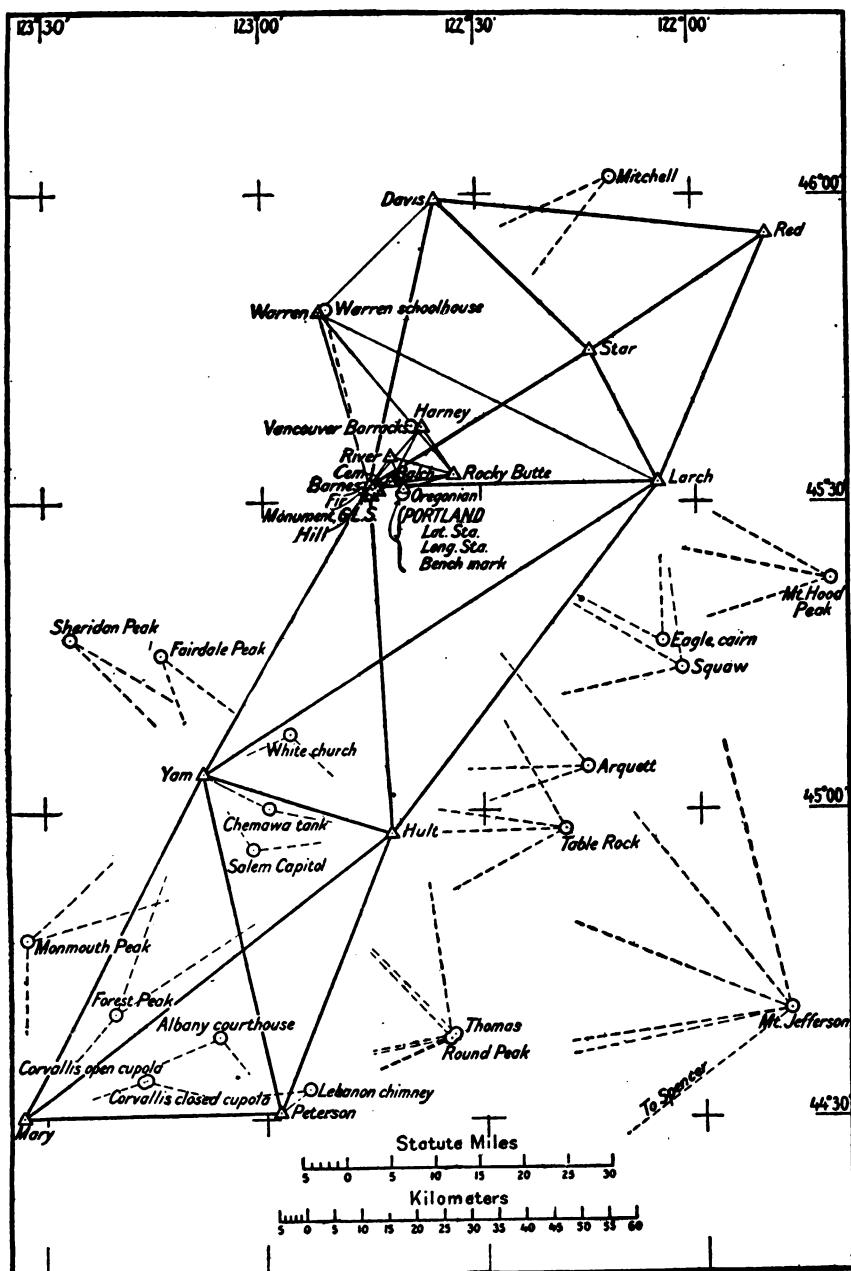


Fig. 6.—TRIANGULATION, VICINITY OF EUGENE, OREG., TO VICINITY OF PORTLAND, OREG.

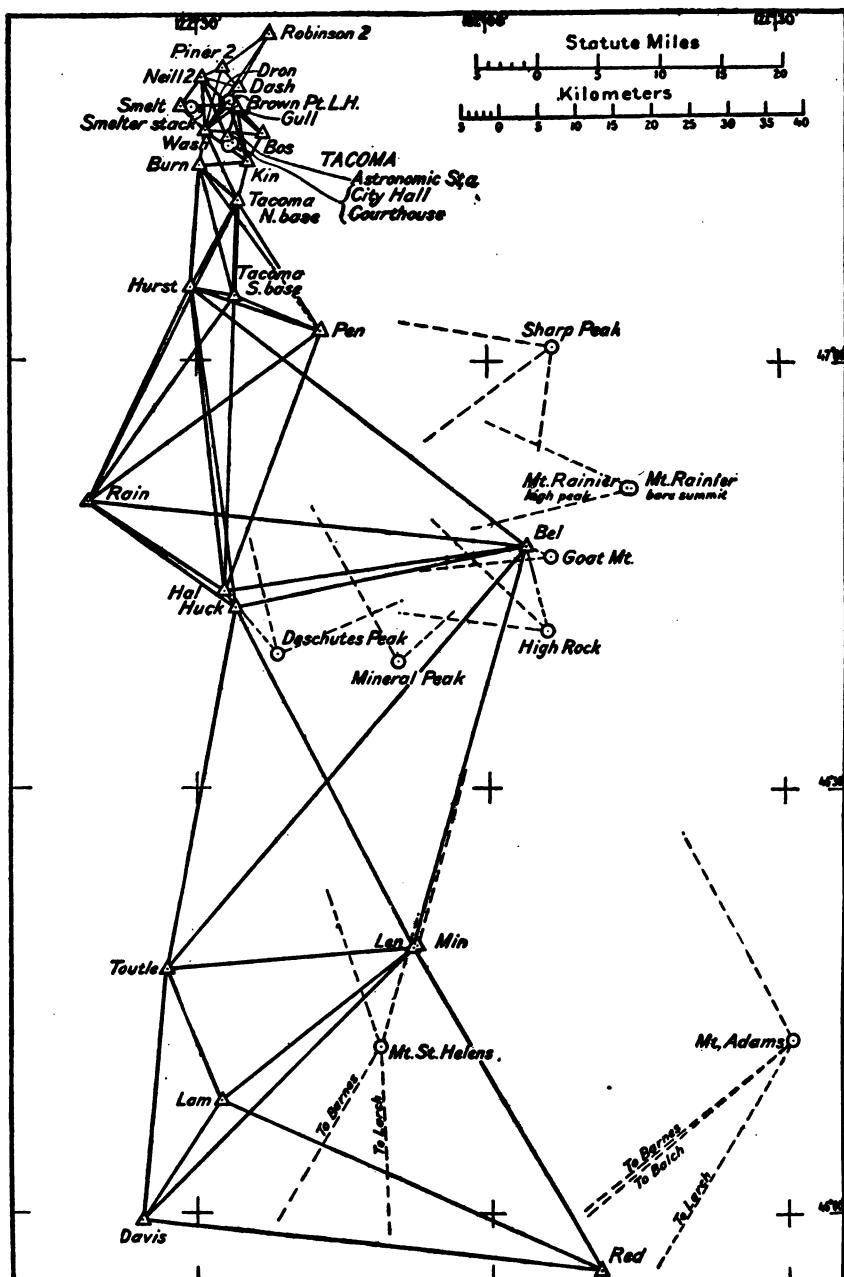


Fig. 7.—TR ANGULATION, VICINITY OF PORTLAND, OREG., TO TACOMA, WASH.

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